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DATA OF ELECTRICAL MANUFACTURING.

The Census Bureau has just issued a preliminary report, reprinted elsewhere, dealing with the production of electrical apparatus and machinery, and representing the general results of the thirteenth census of 1909, as applied to manufacturing establishments. The five-year periods for this work do not coincide with those for the electrical industries consuming the apparatus, as such figures were last taken in 1907, and, according to the law, will be taken again in 1912. This absence of synchronism is to be regretted, for if all the statistics of production and consumption were taken together, we could get a better insight into general conditions in the electrical industries as a whole, as one art, and could better understand some features which, as in the present report, are decidedly puzzling.

The gross results show a marked gain in 1909 over 1904, at a rate of about 10 per cent per annum. In earlier years the gain was at a higher rate, even as much at times as 20 per cent; but it is obvious that such gains would be increasingly difficult to maintain as the volume of trade increased in magnitude. The number of establishments rose from 912 to 1255, but the significance of this increase cannot be determined until the figures are published in detail, when it will probably be found that the growth has been largely confined to smaller plants doing a local business. The value of the product at the factories—that is, including no profits—was $243,967,329, as compared with $159,551,402, a total increase of $84,416,927. Our own estimate for the year, published in these pages at the beginning of 1910, was $275,000,000, but that included some figures not embraced here, such as poles and cross-arms, automobiles as such and other items, so that the guess was remarkably close. It is when we come to separate and individual figures that the data become somewhat difficult of comprehension. Perhaps the total and the figures in the table as a whole, given on page 612 of this issue, would have been larger if taken in a year during which the effects of the panic of 1907 were not so distinctly felt. It must be remembered that 1904-05 was the time when our last "boom" was reaching its tremendous crest, and that electrical development has barely yet, in all its lines, got back to the normal.

Turning to the table, one is immediately struck with the small output of dynamos in value. The gain in the five years was only $2,000,000—from $11,084,234 to $13,081,048; and the increase in number was barely 700. The increase in size of generating machinery probably had an influence on the selling price, but, on the other hand, the figures for the single year are most probably not at all representative of average conditions for the five-year period, which remark also doubtless applies to other entries. The great

increase in the double-generator class, which rose from $1,740,534 to $3,154,733, is also puzzling. It will be noted that the figures are very satisfactory in all the motor classes, although the number of motors for automobiles, given as only 2796, is quite disappointing. The revival of the electric automobile had not, however, become very marked two years ago, and it is quite likely that the output of 1909 will be much more than doubled in 1911. The great increase in storage-battery output, from $2,645,749 in 1904 to $4,678,209, or nearly 100 per cent, clearly indicates that power plants continue to be large purchasers of batteries, especially for emergency service, and, of course, the return of the electric automobile to its old activity also means a stimulus to the battery industry, as does also the extension of railroad-car electric lighting.

Another instance of figures that are puzzling is found in the data given as to telephones. It will be seen that the value of this group of apparatus is given as $15,546,852, as compared with $15,863,698 in 1904, an actual falling off, though slight. It is rather hard to accept this showing; but, as in all the other cases, the figures compiled are the manufacturers' own, and there is no apparent reason why they should indulge in understatement. On looking up the Bell telephone report we note an increase of 600,000 stations that year. Some inferences are that the prices were much lower than in earlier years; that the "Independent" activity has slackened appreciably, though that might be denied; and that the disparity is in part due to the figures for the single year not being truly representative of the concurrent expansion of the operating industry. Perhaps the best criterion of the industry is afforded by the figures for insulated wires and cables, which were $34,520,000 for 1904 and $50,338,000 for 1909. A most surprising decrease is to be noted in the number of arc lamps, and with that goes the entire disappearance of the item of carbons. As tungsten street lighting dates only from about 1909, an explanation that occurs is that central stations were holding back awaiting developments in the street use of tungstens, and also in the use of the composite electrode group of arc lamps. As for carbons, the explanation seems to be that the industry has become so concentrated that to give the figures would virtually reveal the actual business of one large concern, and in all such cases the Census Office dumps the item into "all other products." It would be interesting, however, to see the actual figures, for the information they would carry.

Unfortunately, this policy of concealment of data, when it is applied in another manner to other products, utterly vitiates some of the statistics of the report. Thus, it is stated in the report that, for the reason above given, statistics for railway motors cannot be shown separately, and this product is lumped with motors "for elevators and miscellaneous services, including supplies and parts." The totals under this head show only an increase from $10,707,000 in 1899 to $11,036,000 in 1909, thus, so far as these figures alone go, indicating a stagnation in the electric railway industry during the intervening decade. In point of fact, the number of cars increased from 58,569 in 1899 to 91,153 in 1909, while the total capitalization of the industry increased almost $3,000,000,000 during the same period. But the most glaring instance of this policy is with respect to incandescent lamps. The year 1909 may be accepted as the commercial beginning in this country of the metallic-filament lamp industry, and the figures for that year would have both an industrial and a historical interest as first statistics. We find, however, that the statistics for this type of lamp are combined with those for the graphitized-filament lamp, thus completely concealing the output of the former. It is just possible that the Census Office in this case was misled by the trade designation—metallized filament—of the graphitized carbon-filament lamp. As between the policy of giving no statistics for a product practically controlled by one manufacturer, such as carbons, and that of combining the figures for products that have quite different industrial significances, the former appears to be much the wiser. Moreover, we believe that the Census Office is more solicitous than the conditions of present commercial competition demand, in concealing the actual state of parts of the electrical industry by the methods above noted. The aggregate figures of the report can be accepted as meaning something; these are full of encouragement and indicate that the electrical manufacturing industry is still subject to the powerful impetus which has made electrical development in general one of the marvels of modern times.

APPROXIMATE CALCULATION OF REGULATION.

Extreme refinement in calculations relating to the determination of the proper wire sizes for certain duties usually represents an unnecessary expenditure of thought and labor, in view of the fact that the final choice will in any case fall between two different standard sizes of wire differing appreciably in cross-sectional area, one or the other of which must be selected for commercial reasons quite independent of the exact size which theoretical calculation would show to be most advantageous. For this reason simple approximate methods for calculating line characteristics are preferable to the more exact complicated methods for practical engineering service. Simple approximate formulas may readily be derived from complicated equations by neglecting certain terms of higher order, by ignoring certain quantities which are small in comparison with other quantities with which they are combined, or by substituting one trigonometric function for another in cases where the angle approaches certain limiting values, such as using the sine for the tangent of the arc when the angle is small. A combination of algebraic and geometric simplification in connection with the approximate calculation of the regulation of transformers and transmission lines is described by Mr. H. Bewlay in an article in this issue. The author develops an algebraic method for determining the ratio between certain parts of a graphical diagram of the voltages involved, which method overcomes the well-known disadvantage of the plain graphical method in representing to a single scale values that differ too widely to permit of accurate measurement. The results obtained by the method are subject to error in every case, but the error becomes of importance only when the quantities involved do not differ widely in magnitude, in which cases the purely graphical method can be employed advantageously. It would seem that the method described is well adapted for application in connection with the purely graphical method, these two simple methods covering all cases liable to occur.

PRACTICAL POLITICS AND A GREAT PUBLIC UTILITY.

An example of the unfortunate results that may follow the control of public-service utilities by politicians is afforded by the long-drawn-out controversy among the trustees of the Sanitary District of Chicago. The Sanitary District is a municipal corporation organized under the laws of the State of Illinois to build and operate the Chicago Drainage Canal, primarily designed to afford an outlet for the sewage of Chicago through the Desplaines and Illinois Rivers into the Mississippi River, to preserve Lake Michigan, which is the source of the domestic water supply of Chicago, from contamination. Incidentally, a considerable water-power has been created, and electrical energy, generated at a hydroelectric station at Lockport, Ill., is produced and sold, principally to the city of Chicago and other municipal bodies, for street lighting or other municipal purposes. Electricity is also sold to private consumers, mainly for industrial use, and thus the District competes with the privately owned electric-service companies of Chicago and vicinity.

The affairs of the District are managed by a board of nine trustees elected by the people. One of these serves as president, but he is not selected by his fellow-members, but is elected directly to this position by the voters, a requisite being, of course, that he must also be elected a member of the board. On Dec. 1, 1910, there was a change of administration by which a president was elected of opposite political faith to that of the majority of the trustees. Immediately a difficult situation was created, and since then the business of the board has been in a sad tangle. The president and the majority of the other trustees in the preceding administration were of the same political persuasion, and the president was allowed to take the predominant part in the government of the District to which his office would seem to entitle him. But with a president of one party and a majority of the trustees of another there was trouble, and plenty of it. A struggle for control ensued, the minority, having the president's office, being strong enough to block the efforts of the other trustees to take the direction of affairs. Angry scenes have marked the sessions, and on more than one occasion physical encounters have been narrowly averted. Pay-rolls have been held up; employees have been discharged by some trustees and told to remain by others; there have been acrimonious disputes delaying the awarding of important contracts; charges and countercharges have been bandied about with the utmost freedom. In short, the administration of the District has been marked for several months by disorder and tumult.

In its engineering aspects the Chicago Drainage Canal is a great work. The electrical plant is modern and well built and has been operated efficiently, or at least was so operated until the deadlock in the governing body brought about a situation which must have affected all departments unfavorably. It is particularly unfortunate that this political squabble has arisen, for a contract was executed in October, 1910, by which the city of Chicago turned over to the Sanitary District its whole street-lighting equipment, comprising thirteen stations and substations and approximately 12,200 arc lamps, with overhead and underground lines, the District agreeing to manage and operate the system for a period of seven years and also to install at least three additional substations and 10,000 additional 450-watt arc lamps. This is a contract of great moment to the people of Chicago and was apparently advantageous to all parties concerned when executed. The Drainage Canal was built by the people's money and there would appear to be no better method of applying the cheap electrical energy created than to use it for public street lighting, especially as the outlying areas of Chicago's wide expanse are notoriously poorly lighted. It may be that the quarrels of the trustees have had no very serious effect, so far, in the carrying out of this contract, for orders have been placed already for a considerable proportion of the new material needed; but such intestine dissension as has been witnessed does not make for confidence in the administration of such a vital utility as the public street lighting of a great city. The unfortunate condition of affairs in the Sanitary District furnishes a recent and conspicuous demonstration of the truth that politics has no place in the administration of public utilities.

RESISTANCE-TEMPERATURE CHARACTERISTICS OF THE NERNST GLOWER.

It is a noteworthy fact that the terms "conductor" and "insulator," although so applied as to have definite significance under ordinary practical conditions, are relative only in that what may be termed an insulator under certain conditions becomes a conductor under certain other conditions. For example, the various metals which are designated as conductors at normal temperature become excellent and almost perfect insulators as the temperature is decreased toward absolute zero. On the other hand, the so-called insulating materials become excellent conductors as the temperature is increased indefinitely. It is upon the latter fact that the operation of the Nernst lamp glower depends, the glower being made from material which is a good "insulator" when cold. By preheating the glower is converted into a fair "conductor," which permits current to be produced to assist in heating the glower until it reaches the temperature of incandescence, which temperature is then maintained by means of a series resistor which acts to limit the current in the glower. A study of the resistance changes in a Nernst lamp glower as the temperature was increased from 400 deg. C. to 1350 deg. C. is recorded in an article by Mr. Albert A. Somerville in this issue. At 400 deg. C. the resistance of the glower tested had the enormous value of 8×10^6 ohms; it decreased to 29×10^3 ohms at 800 deg., to 3.7×10^3 at 1200 deg. and to 2.45×10^3 at 1350 deg. The figures show a conductivity about forty times as large at 600 deg. as at 400 deg., 7.0 times as large at 800 deg. as at 600 deg., 3.1 times as large at 1000 deg. as at 800 deg., 2.5 times as large at 1200 deg. as at 1000 deg., and about 1.6 times as large at 1400 deg. as at 1200 deg.

At the highest temperature which was reached during the tests the conductivity was found to be only one-fourth as large as under normal operating conditions, and hence it would seem that the tests were conducted at temperatures possibly 800 deg. below the operating value. It is to be hoped that the tests will be extended through the higher temperature range and to include a study of the luminosity of the glower at the different temperatures, in view of the departure of the glower from the theoretical black-body radiation.

Convention of Pennsylvania Electrical Association.

By Telegraph.

With a registered attendance of 235 the fourth annual convention of the Pennsylvania Electrical Association was opened at Exposition Park, Pa., Sept. 5, under clouded skies. The reception at the dancing pavilion on Tuesday night to President and Mrs. A. R. Granger was somewhat marred by a terrific downpour of rain, but otherwise the affair was agreeably cordial and thoroughly enjoyable. The convention headquarters are at Hotel Conneaut, fronting on Conneaut Lake, with an overflow in the Hotel Virginia, which is under the same management. Exposition Park itself is a noted summer resort within easy reach of Pittsburgh and Erie. It possesses numerous natural advantages besides the charming lake on which it is situated and abounds with almost every form of outdoor amusement, both on land and water, including a baseball park, race track, large amphitheater, picnic grounds and the usual side shows found in seaside and summer resorts.

The first general session was opened a half hour after the scheduled time. In his address President A. R. Granger, of Chester, Pa., called attention to the remarkable growth of the association during the past year, the membership reaching 954 as against 492 last year, a gain of about 100 per cent.

Owing, he said, to the large number of geographical sections of the National Electric Light Association the executive committee of the national body has decided that it will be impracticable hereafter for the presidents and chairmen of such sections to be ex-officio members of that committee. The geographic sections combined will, however, have two votes in the national committee as provided in a recent amendment to the constitution. During the past session of the State Legislature the executive committee held several meetings regarding bills introduced in the Senate and House of Representatives and action was taken whereby discriminatory and unjust legislation was defeated. President Granger urged that in matters of this kind a greater co-operative spirit be shown than in the past, as it is not always possible for the executive committee to bring about a desired result unless aided by the entire association membership. In view of the very rapid growth of the national body it was felt that in a very short time the state and geographic sections will take up a large part of the work now carried on by the parent body. Therefore the president said it behooved the state associations to continue to broaden their usefulness so that when they are called upon partially to fill the place of the national body they will be in a position to do so. He expressed the hope that in this movement the Pennsylvania Electrical Association would blaze the way.

The reports of the standing committees were then presented. According to the membership committee there are at present eighty-five active, 842 class B (members connected with central stations) and twenty-six associate members. A new set of by-laws was adopted because of the changes incident to affiliation with the National Electric Light Association. All that could be desired in the way of entertainment for the ladies and others present, in addition to the members of the association, has been provided by the entertainment committee.

The first paper of the session was the report of the lamp committee, read by Mr. H. M. Simkins, of Philadelphia, in the absence of the chairman, Mr. A. J. Spillman, who is seriously ill. The committee points out that the tendency of the lighting companies during the past year has been to replace carbon with graphitized-filament lamps and tungsten lamps, a charge being made for the latter depending on the policy of the different companies. The substitutions of the graphitized-filament lamp for the old carbon-filament lamp the committee considered to be a very logical move, giving the consumer 20 per cent additional illumination for the same energy consumption. Experience has shown that where lighting companies have encouraged and at the same time controlled the general use of the tungsten lamp a marked improvement in new business, extension of old business and relations with the consumers has resulted. The committee cited the improvements made in the manufacture of the tungsten lamp and stated that the wire-drawn tungsten filament is several times stronger than the pressed tungsten-filament lamp. For residence work 25-watt and 40-watt sizes are the most popular, being more particularly suited to replace carbon lamps, while the 150-watt and 250-watt lamps make satisfactory substitutes for arc lamps and offer a means of competing with the so-called gas arc. The watt rating with three voltages was explained and it was pointed out by the committee that under general conditions it is most desirable from the consumers' as well as from the lighting companies' viewpoint to operate the lamp at the highest rating. Embodied in the report is a list giving the substance of the replies of member companies to eleven question submitted to them with reference to the tungsten lamps. Commercial practice has been greatly modified since the introduction of the high-efficiency lamp, and with the possibility of these lamps being made more efficient in the future it is necessary, in the opinion of the lamp committee, for central-station companies to adopt policies, programs and methods which will not only take care of the lamp situation at present, but will provide for any increase in efficiencies in years to come.

In the discussion Mr. H. Harris, of Wilmerding, asked the committee if its recommendation was in favor of the wire-drawn tungsten lamp as against the pressed-filament tungsten lamp and if the former is giving better results as regards stability. Mr. E. F. McCabe, of Titusville, expressed his disappointment with the drawn-tungsten-filament lamps. He said from the glowing descriptions given by the manufacturers he was led to expect excellent results, whereas, as a matter of fact, the lamp is no better than the old pressed-tungsten-filament lamp; although it is stronger when new, it depreciated rapidly after being used and the fluttering was just as noticeable. In his estimation there is still room for vast improvement. Mr. H. N. Mueller, of Pittsburgh, said that the flutter of the lamps is due to mechanical and chemical reasons; in his opinion, the tungsten drawn-wire filament is mechanically stronger than the pressed-tungsten filament. The blackening of the bulb, he said, is doubtless due to some chemical in the filament or binder. The only improvement made, in his estimation, has been the mechanical strengthening of the filament. Mr. Van Dusen Rickert, of Pottsville, told of difficulties and excessive breakage of tungsten sign lamps operated on a flasher, the lamps apparently all breaking at the same point. By shortening the interval between flashes from 60 per cent to 85 per cent the trouble was greatly reduced. Mr. E. L. Franklin, of Easton, asked about the cost of the change from free carbon to free graphitized-filament lamps. Mr. Mueller suggested that where excessive breakage occurred with low-voltage sign lamps enough energy should be supplied to keep the filament soft and hot at all times without actually lighting the lamps; he said that electric railways do this to advantage. Mr. E. F. McCabe, of Titusville, asked whether the saving in the use of the low-voltage tungsten lamp with transformers was sufficient to justify the expense and complication. Mr. H. N. Mueller, of Pittsburgh, said the series operation of low-voltage tungsten lamps could not be compared with the multiple operation in connection with a transformer, especially where the latter is provided with taps; if the voltage be lowered from 5 per cent to 10 per cent the effect on the brilliancy is not noticeable and the life of the lamps is considerably prolonged. Speaking for the lamp manufacturers Mr. Mason said that the mechanical strength of the drawn-tungsten filament is five times greater than that of the pressed-tungsten filament. After being 100 hours in

service, however, the filament crystallizes, but not so much as the pressed-tungsten filament. The strength then is from two to three times as great as that of the latter filament, but the characteristics are about the same in both. It is impossible at present, he said, to make either the drawn-filament or a pressed-filament tungsten as uniform as the old carbon filament. Mr. E. B. Greene, of Altoona, related his experiences with the tungsten lamp on circuits controlled by a flickering indicator. By substituting tungsten lamps rated 8 volts higher than that of the circuit on which they are burned excellent life is obtained. Previously his experience was identical with that cited by Mr. VanDusen Rickert at Pottstown, the flickering device acting similarly to the flasher in the case mentioned. Mr. J. E. Pyle, of West Chester, also experienced blackening trouble when he used tungsten lamps at the highest rated voltages. His company now employs 120-volt lamps on 116-118-volt circuits with good results: one 150-watt tungsten lamp used on a circuit 3 volts lower than that for which the lamp was rated burned over 4000 hours and is still in service, although slightly blackened.

The next paper was the report of the steam-heating committee read by the chairman, Mr. M. J. Fogarty, of Erie, a paper on central-station heating by Mr. E. J. Kiefer, of Easton, forming part of the report. The committee found it difficult to procure data from heating companies and that it is impracticable to give a full detailed statement of the many items involved in steam heating. A uniform rate is also out of the question. The prevailing rate charged by 100 companies in various states averages 45 cents per 1000 lb. of condensation. Many plants have added exhaust steam turbines and others have added ice-making appliances to their equipment. The latter seems to have a tremendous advantage over the ordinary ice plant or over the natural ice harvester, as pure ice can be made by using steam at from 2 lb. to 3 lb. pressure, thus utilizing exhaust steam twelve months in the year if necessary. The paper was discussed by Messrs. L. H. Conklin, Warren E. F. McCabe, Titusville; J. E. Pyle, West Chester; W. J. Kline, Lockport, N. Y.; F. M. Noecker, Renovo; E. H. Davis, Williamsport; Duncan Campbell, Scranton, and R. S. Orr, Pittsburgh.

Following the presentation and discussion of the report of the steam-heating committee the report of the committee on overhead line construction was presented in abstract, the actual reading of the report and its discussion being reserved for Thursday's session. In presenting the abstract the chairman of the committee, Mr. F. M. Noecker, of Renovo, said that the committee made special efforts to get members of the association to consider carefully the questions raised. The report recommends important changes in all the sections of the N. E. L. A. report, but the real bone of contention is Section 4 of the latter. New ideas have been followed up and put into practice on the subject of cross-arms, wooden pins and metal insulator supports, as well as on the methods of secondary distribution in general. The subject of vertical runs on poles jointly used was only briefly touched on in the report, but will be elaborated in the discussion. The reference to the specification for weatherproof wire needs to be supplemented by the views received by correspondence with manufacturers. The purpose of the committee was to criticise the national report and the committee feels that anyone reading its report will admit that it has done its duty. It has not criticised, however, for the sake of criticising, but rather for the sake of securing the greatest good for the greatest number. The report is distinctly a committee report and not a chairman's report. It is supplemented by a paper on the preservative treatment of poles and cross-arms by Prof. J. P. Jackson, of Pennsylvania State College, and another containing additional information on sags and spans by Mr. W. L. Robertson, of Philadelphia.

During the morning the ladies formed card parties and the afternoon was given over to track sports, including a tug-of-war, baseball game and horse racing. At night the entire convention attended a theatrical performance in the hall in which the sessions of the association were held. President Gilchrist was expected to address the convention on Thursday morning, coming direct from the meeting of the incandescent lamp manufacturers at Association Island, New York, for that purpose.

Census Report on Electrical Machinery and Apparatus.

A preliminary statement showing the general results of the thirteenth census of establishments engaged in 1909 in the manufacture of electrical machinery and apparatus has been issued by the United States Census office. It presents a comparative summary of the statistics of the industry for the censuses of 1909, 1904 and 1899, and shows the number and value of the different kinds of electrical equipment manufactured during each census year. The report was prepared under the direction of Mr. William M. Steuart, chief statistician for manufactures.

The reports were taken for the calendar year ended Dec. 31, 1909, wherever the system of bookkeeping permitted figures for that period to be secured, but in some instances where the business year of an establishment differed from the calendar year they relate to the business year falling most largely within 1909.

The value of the machinery and apparatus manufactured for use in the generation and utilization of electricity increased from $105,832,000 in 1899 to $159,551,000 in 1904, and $243,967,000 in 1909, or 130 per cent during the decade. Large quantities of supplies used for electrical purposes are manufactured in foundry and machine shops and other establishments not identified with the electrical industries. These parts are assembled by dealers and others not covered by the census, and it is impossible to obtain accurate information in regard to them. Therefore, the totals given above are less than the true total value of all of the machinery of this character manufactured annually in the United States.

The value of products represents their selling value or price at the plants as actually turned out by the factories during the census year, and does not necessarily have any relation to the amount of sales for that year.

DYNAMOS.

The number of dynamos manufactured annually increased from 10,527 in 1889 to 15,080 in 1904, and 16,791 in 1909, an increase of 59 per cent for the decade. The value of the dynamos for each year was $10,473,000, $11,084,000 and $13,081,000 respectively. As a rule, much larger and more powerful dynamos were manufactured in 1909 than for the prior years, so that while the average value of machines manufactured was greater in 1909 they represented a lower cost for corresponding capacity. The average capacity per machine increased from 55 kw in 1899 to 66 kw in 1904 and 84 kw in 1909. The value of the dynamotors, motor-generators, boosters, rotary converters and double-current generators manufactured increased from $380,000 in 1899 to $3,155,000 in 1909, or 730 per cent.

TRANSFORMERS AND SWITCHBOARDS.

The value of transformers manufactured increased from $2,963,000 in 1899 to $4,469,000 in 1904, or 51 per cent, and to $8,801,000 in 1909, or 197 per cent. The value of switchboards, panelboards and cut-out cabinets for lighting and motors increased from $1,847,000 in 1899 to $3,766,000 in 1904, or 104 per cent, and to $5,972,000 in 1909, or 223 per cent.

MOTORS.

The total value of motors of all kinds, including supplies and parts, manufactured increased from $19,505,000 in

1899 to $22,371,000 in 1904, and $32,087,000 in 1909, or 64 per cent for the decade.

The number of power motors manufactured annually increased from 35,604, valued at $7,551,000, in 1899, to 79,877, valued at $13,121,000, in 1904, and to 244,123, valued at $18,306,000 in 1909, there being an increase of 586 per cent in number and 142 per cent in value for the decade. Many powerful motors were manufactured, but the number of small motors has increased so rapidly that the average capacity per machine has declined, the average horsepower per motor for the three census years being 14.5, 8.5 and 6.7 respectively.

In 1899 there was great activity in the manufacture of motors for automobiles, but the increase in this branch of industry has not kept pace with that for other classes of electrical equipment. The number manufactured decreased from 3017 in 1899 to 1819 in 1904, with an increase to 2796 in 1909. On the other hand, the capacity of motors reported increased 4251 hp, or 52 per cent, during the decade, and the value of these motors has decreased from $192,000 in 1899 to $153,000 in 1904, but increased to $294,000 in 1909.

The number of small motors for the operation of fans has increased very rapidly. There were 97,577 such motors reported in 1899. In 1904 there were 102,535 and in 1909 199,113, an increase of 104 per cent for the decade. The value of these motors increased from $1,055,000 in 1899 to $2,451,000 in 1909, or 132 per cent.

The report states that the statistics for motors for electric-railway cars cannot be shown separately without disclosing the products of individual establishments, but there was a considerable increase in the manufacture of such motors as compared with the production of 1904, which was 12,298, of 713,181 hp, valued at $4,950,000. Considering the group of motors for cars, elevators and similar purposes the combined number decreased from 23,582 in 1899 to 22,112 in 1904, and increased to 58,698 in 1909. The value of these motors was $10,707,000 in 1899, $7,929,000 in 1904 and $11,036,000 in 1909, there being an increase of 149 per cent in number and 3 per cent in value during the decade, the decrease shown for the group in 1904 being entirely due to the decrease in the manufacture of railway motors at that census.

STORAGE AND PRIMARY BATTERIES.

The value of the storage and primary batteries manufactured increased from $3,679,000 in 1899 to $4,244,000 in 1904 and $10,612,000 in 1909, or 188 per cent during the decade. Both storage and primary batteries consist of various elements which are not always combined and sold together as a unit by the same manufacturers, and yet it is not until these are brought together that a complete cell is constituted. Many of the parts and supplies used are manufactured outside of the electrical field, and therefore the statistics shown in this report do not convey a correct idea of the importance attached to this branch of the industry.

ARC AND INCANDESCENT LAMPS.

The number of arc lamps manufactured increased from 158,187 in 1899 to 195,157 in 1904, and decreased to 123,543 in 1909. The decrease is accounted for by the fact that other varieties of lamps are now used for street light and for other purposes for which arc lamps were formerly used almost exclusively. The value of these lamps decreased slightly in 1904 ($1,574,000) as compared with 1899 ($1,828,000), but owing to the introduction of more costly types of these lamps, such as flaming arcs, increased to $1,707,000 in 1909.

The group of incandescent lamps includes carbon-filament, gem, tantalum, tungsten, glower-vacuum, vapor and similar lamps used for lighting, advertising and decorative purposes. Some of these varieties were not manufactured in 1899 or 1904. A large number of decorative and miniature lamps, X-ray bulbs, vacuum tubes, etc., are now manufactured, but the varieties are so numerous that it is impossible to obtain accurate statistics of the number. The total value of the group increased from $3,515,000 in 1899 to $6,953,000 in 1904 and $15,715,000 in 1909. The value of the carbon-filament lamps increased rapidly from 1899 to 1904, but there was a slight decrease in 1909, the value for the respective years being $3,442,000, $6,308,000 and $6,157,000. The report states that the manufacture of gem, tantalum, tungsten and other metal-filament lamps was reported separately for the first time at the census of 1909.

TABLE I.—ELECTRICAL MACHINERY, APPARATUS AND SUPPLIES.

Items.	1909.	1904.	1899.
Number of establishments	1,255	912	581
Total value of products	$243,967,000	$159,551,000	$105,832,000
Dynamos:			
Number	16,791	15,080	10,527
Total kilowatts	1,405,951	996,182	578,124
Value	$13,081,000	$11,084,000	$10,473,000
Dynamotors, motor-generators, boosters, rotary converters and double-current generators	3,155,000	1,740,000	380,000
Transformers for light and power	8,801,000	4,469,000	2,963,000
Switchboards, panel boards, cut-out cabinets for light and power	5,972,000	3,766,000	1,847,000
Motors:			
For power—			
Number	244,123	79,877	35,604
Horse-power	1,623,677	678,910	515,705
Value	$18,306,000	$13,121,000	$7,551,000
For automobiles—			
Number	2,796	1,819	3,017
Horse-power	12,471	19,907	8,220
Value	$294,000	$153,000	$192,000
For fans—			
Number	199,113	102,535	79,577
Horse-power	178,033	30,796	12,766
Value	$2,451,000	$1,168,000	$1,055,000
For railways, elevators, and miscellaneous services, including supplies and parts—			
Number	58,698	22,112	23,583
Horse-power	859,237	763,399	684,791
Value	$11,036,000	$7,929,000	$10,707,000
Storage batteries, including parts and supplies:			
Weight of plates in pounds	23,119,331	16,113,073	
Value	$4,678,000	$2,646,000	$2,560,000
Primary batteries including parts and supplies:			
Number	34,333,531	6,623,162	2,654,765
Value	$5,934,000	$1,598,000	$1,119,000
Arc lamps:			
Number	123,543	195,157	158,187
Value	$1,707,000	$1,574,000	$1,828,000
Searchlights, projectors, and focusing lambs	936,000	115,000	226,000
Incandescent lamps:			
Carbon-filament, gem, tantalum, tungsten lamps	13,839,000	6,308,000	3,442,000
Decorative and miniature lamps, X-ray bulbs, vacuum tubes, etc. (also includes glower lamps and parts, and vacuum and vapor lamps)	1,876,000	645,000	73,000
Sockets, receptacles, bases, etc	4,522,000	2,011,000	594,000
Electric-lighting fixtures of all kinds	6,128,000	3,295,000	3,751,000
Telegraph apparatus	1,957,000	1,111,000	1,642,000
Telephone apparatus	15,547,000	15,864,000	10,512,000
Insulated wires and cables	50,338,000	34,520,000	21,292,000
Electric conduits	5,098,000	2,416,000	1,066,000
Annunciators — Domestic, hotel, and office	236,000	186,000	225,000
Electric clocks and time mechanism	352,000	374,000	132,000
Fuses	1,002,000	868,000	595,000
Lightning arresters	940,000	587,000	
Rheostats and resistances	2,675,000	933,000	1,187,000
Heating, cooking and welding apparatus	1,003,000	396,000	
Electric flatirons	951,000		
Electric measuring instruments	7,800,000	5,005,000	1,842,000
Electrical therapeutic apparatus	1,116,000	1,037,000	
Magneto-ignition apparatus, spark-coils, etc	6,080,000	678,000	
Electric switches, signals and attachments	5,384,000	1,451,000	1,130,000
Circuit fittings of all kinds	1,081,000	3,525,000	
All other products	34,000,000	26,179,000	15,384,000
Amount received from custom work and repairing	5,691,000	2,799,000	2,064,000

when they were valued at $7,682,000. Some of these new varieties of lamps were not reported separately at prior censuses, and it is possible, the report says, that they were included with the carbon-filament lamps, thus accounting in part for the apparent decrease in that variety of lamp. Advertising, decorative and all other lamps, including in 1909 glower lamps, vacuum and vapor lamps not separately reported in 1904, have increased in value from $645,000 in 1904 to $1,876,000 in 1909.

The total value of all lamps reported for 1909 was $15,715,000. This does not include sockets, receptacles, bases, etc., or lighting fixtures of any character.

LIGHTING FIXTURES.

The value of electric-light fixtures of all kinds manufactured in 1899 was $3,751,000; in 1904, $3,295,000, and in 1909, $6,128,000. Large quantities of combination and gas and electric fixtures are now manufactured. At the census of 1909 it was ascertained that the value of these combination fixtures was about $12,884,000. Their value for prior censuses cannot be ascertained, and there were undoubtedly large quantities manufactured in connection with the manufacture of gas fixtures which are not identified with the manufacture of electric supplies and their value is not included in this report.

TELEGRAPH AND TELEPHONE INSTRUMENTS.

The telegraph instruments include intelligence (key, sounder, etc.) of all kinds, police, fire, district and miscellaneous instruments, wireless apparatus, also switchboards and telegraph parts and supplies. The total of this group of instruments in 1899 amounted to $1,642,000, in 1904 to $1,111,000 and in 1909 to $1,957,000, an increase of 19 per cent in the decade.

Telephone apparatus includes transmitters, receivers, complete sets of instruments (not included in the separate parts), interior telephone systems complete, and central switchboards, private-exchange boards, parts and supplies. The total value of this group in 1899 was $10,512,000 as compared with $15,864,000 in 1904 and $15,547,000 in 1909, a slight decrease during the last five-year period.

The report also shows the value of the total annual output of miscellaneous apparatus used in connection with the utilization of electric energy. Principal among these may be mentioned electric measuring instruments, the output for which in 1909 was $7,800,000; magneto-ignition apparatus, sparks, coils, etc., valued at $6,080,000; electric switches, signals and attachments, $5,384,000; heating, cooking and welding apparatus, $1,003,000; lightning arresters, fuses, etc., valued at $1,942,000; therapeutic apparatus, $1,116,000; circuit fittings, $1,081,000, and electric flatirons, $951,000.

TABLE II.—ESTABLISHMENTS MANUFACTURING ELECTRICAL APPARATUS INCIDENTALLY.

Year.	Number of Establishments.	Value of Product Reported.
1909	246	$22,660,000
1904	128	18,742,000
1899	....	13,397,000

TABULAR SUMMARY.

The accompanying Table I summarizes the statistics for the principal products as reported at the censuses of 1909, 1904 and 1899.

Table II includes establishments not engaged primarily in the manufacture of electrical products, but incidentally making electrical machinery, apparatus and supplies.

Chicago I. E. S. Convention.

At the fifth annual convention of the Illuminating Engineering Society, which will be held in the Congress Hotel, Chicago, Sept. 25 to 28, a wide variety of topics will be covered by the reports and papers to be presented. The final program has as yet not been arranged, but the following is the tentative program subject to revision.

Presidential address by Dr. A. E. Kennelly on *The Relations of Physico-Physiological Research to Illuminating Engineering;* report of committee on nomenclature and standards, Dr. A. C. Humphries, chairman; report of committee on progress, Dr. Louis Bell, chairman; symposium on illuminating glassware, by Messrs. A. J. Marshall, L. W. Young, G. H. McCormick, F. L. Godinez and Bassett Jones, Jr.; *The Manufacture of Glass from the Viewpoint of the Illuminating Engineer,* by Mr. E. H. Bostock; *An Analysis of Requirements in Modern Reflector Design,* by Mr. F. L. Godinez; *Recent Small Gas-Lighting Units,* by Mr. F. H. Gilpin; *Flames Carrying Electric Current,* by Mr. C. F. Lorenz; *The Production and Form of Natural Gas from the Illuminating Engineer's Standpoint,* by Mr. G. S. Barrows; *Recent Developments in the Manufacture of Incandescent Lamps,* by Mr. J. E. Randall; *The New Quartz-Tube Mercury-Arc Lamp,* by Mr. George C. Keech; *The Law of Conservation as Applied to Illuminating Calculations,* by Dr. A. S. McAllister; *The Photometry of Lighting Units of High Intensity,* by Messrs George H. Stickney and S. L. E. Rose; *Photometry at Low Intensities,* by Dr. Louis Bell; *Evaluation of Lamp Life,* by Messrs. P. S. Millar and L. J. Lewinson; *Distribution of Luminosity in Nature,* by Dr. H. E. Ives; *Light Distribution—Its Influence Upon Illuminating Efficiency and Visual Acuity,* by Mr. A. J. Sweet; *Résumé of Legislative Enactments on Illumination,* by Mr. E. L. Elliott, and *Selling Illumination,* by Mr. F. B. Rae.

ENTERTAINMENT FEATURES.

The following entertainment features have been provided: A two-hour automobile ride for the ladies with afternoon tea on Monday, Sept. 25. On Monday evening a reception and dance will be held at the Congress Hotel. On Tuesday afternoon there will be an automobile ride for the ladies, with light refreshments at the South Shore Country Club. On Wednesday afternoon the delegates will be taken to various places of engineering interest, while a theater party has been arranged for the visiting ladies. A five-dollar subscription banquet will be held at the Congress Hotel on Wednesday evening.

Program of Fall Convention of N. E. L. A. New England Section.

As previously announced in these columns, the New England Section of the National Electric Light Association will hold its fall convention Sept. 27-29, at the Mount Washington Hotel, Bretton Woods, N. H.

On Wednesday evening there will be an informal reception and dance, and at the first session the next morning the following papers will be presented: *Synchronous Converters,* by Mr. C. T. Mossman, General Electric Company; *The National Electric Light Association System of Accounting as Applied to Small Plants,* by Mr. H. E. Gidney, Malden Electric Company. Thursday afternoon will be devoted to recreation, and in the evening there will be a banquet. The meeting will conclude with a session on Friday morning, at which the following papers will be presented: *The Line-Type Tungsten Lamp,* by Mr. Norman Macbeth, Westinghouse Lamp Company; *Application of Electricity to Domestic Uses,* by Mr. W. H. Vorce, Vermont Power & Manufacturing Company, St. Albans, Vt. Miss O. A. Bursill, Boston Edison Company, 149 Tremont Street, Boston, is secretary of the association.

Boston Automobile Show.

Plans for the Pleasure-Car and Commercial Vehicle Exhibitions to be held in Mechanics' Building, Boston, the former March 2-9, 1912, and the latter March 13-20, 1912, are being matured rapidly. The shows are conducted under the auspices of the Boston Automobile Dealers' Association and the Commercial Motor Vehicle Association. Mr. Chester I. Campbell, secretary of the Boston Automobile Dealers' Association, who is manager of the shows, has issued blank applications and diagrams of space and reports that applications are fast coming in. There will be about 114,000 sq. ft. of exhibition space. Mr. Campbell says that the representation of electric vehicles and cars will probably be larger than ever before, and that the electric interests may have a section by themselves. In view of the fact that electric-driven vehicles have trebled in the past year and a half in the section about Boston, the interest in that class of cars will be much greater than before. The allotment of space will take place on Oct. 1.

Lighting Rates in Toledo, Ohio.

Late last week the Toledo (Ohio) Railways & Light Company sent out notices that all lighting contracts which do not come up to the requirements of the Schreiber ordinance—8 cents per kw-hour with a discount of 1 cent per kw-hour if bills are paid by the 10th of the month—will be abrogated on Sept. 30. Officials stated that a number of contracts provide for a rate lower than this, having been made because of the existence of certain conditions that warranted it at the time. It is estimated that there are about 500 of these contracts in force now. Notices were sent only to those who are paying less than the rate fixed in the ordinance. Those who have such contracts, it is stated, may make temporary arrangements to have the service continued pending the determination of the proper charge through the suit which the city has instituted for that purpose. It is not yet known whether any changes will be made in the charges that are made to the business houses for lighting and motor service. The schedules must be furnished the Public Utility Commission by Sept. 30, and the matter will be decided before that time. City Solicitor Schreiber states that there is nothing in the new ordinance to prevent the company from making a reasonable classification of its lighting consumers so long as it does not exceed the rate fixed, and that the City Council has no legal authority to fix rates for energy consumed for power purposes. This lies between the company and the Public Utility Commission, as changes cannot be made without the consent of the latter.

Canadian Hydraulic Plant Opening at St. Timothy.

The formal opening of the generating plant of the Canadian Light & Power Company took place at St. Timothy (Que.) on Aug. 31. Miss Robert, sister of E. A. Robert, the vice-president and general manager of the company, pushed the button which started the operation of two 8000-hp generators. Although the full capacity of the plant has not yet been placed in operation, practically all of the power developed by the company has already been sold. A large number of shareholders and the directors were present, together with a number of ladies, the party having been conveyed to the power house by special train from Montreal. A luncheon was tendered to the shareholders by the directors.

When the whole installation is completed the generating station at St. Timothy will have a capacity of 75,000 hp, which will all be transmitted to Montreal, to be distributed to customers in that city, among which will be the Montreal Street Railway, control of which was obtained by the Canadian Light & Power interests in November, 1910, at which time Mr. E. A. Robert was elected president of the railway company.

Sanitary District Street-Lighting Contract in Chicago.

Apprehension is felt lest, owing to the political squabbles of the trustees, the Sanitary District of Chicago be seriously delayed in carrying out its contract with the city of Chicago to install and operate 10,000 additional 450-watt arc lamps for street lighting. This contract was executed Oct. 27 of last year, and it provides that the new lamps shall be located and platted by the city electrician at the rate of not less than 500 each month, beginning not later than six months from the date of the contract (or April 27, 1911). When 3000 lights have been located in this way, the locations and plats are to be submitted to the electrical engineer of the Sanitary District, and then he and the city electrician shall determine upon the location of new substations to be constructed by the District.

According to the terms of the contract, further, it is declared that not less than 3000 arc lamps, or their equivalent in other lamps in the consumption of electrical energy, shall be placed in operation in each year for a period of three years. It will be impossible for the first 3000 to be placed in operation within a year from the date of the contract, and this situation is said to be due partly to the delay of the Sanitary District in awarding the contract for lamps and partly to delay on the part of the city electrician in indicating the location of the lamps. The city electrician, again, is said to attribute his delay to the failure of some of the Aldermen to indicate where they wish additional lamps erected in the thirty-two wards of the city.

At present, as already related in the *Electrical World*, the Sanitary District has entered into contract with the General Electric Company and the Stave Electrical Company to furnish 250 flaming-arc lamps, each to be tested under operating conditions for two or three months. The result of this test is intended to influence the awarding of the initial contract for 4000 lamps.

Austin Municipal Hydroelectric Plant.

The contract that was recently entered into by the City Commission of Austin with William B. Johnson, of Hartford, Conn., representing the Hydraulic Properties Company, of New York, for the reconstruction of the large dam across the Colorado River and the installation of a hydroelectric plant, which work shall cost $1,720,000, has just been ratified by vote of the people of the city. Owing to the fact that these public works are to be paid for out of the earnings of the municipal electrical plant, the right to vote on the proposition was not confined to the taxpayers. The original dam was washed away eleven years ago by a flood in the river. Several attempts have been made since then to bring about its reconstruction, but none of the plans was successful. Under the terms of the present contract the city is to pay to Mr. Johnson $100,000 for the completion of the dam and hydroelectric plant, and the rest of the $1,720,000 is to be paid in semi-annual instalments of $32,400 each without interest. The contractor is required to operate the power plant during this term of years and deliver to the city all power generated, being required to install equipment capable of producing 7200 hp. A minimum of 600,000 hp-hours per month is guaranteed. The dam will have a height of 65 ft., which is 5 ft higher than the old dam, and will be of concrete construction. In

case the dam or power plant is washed away the contractor must replace it or lose all unpaid instalments. He is also required to keep the works in first-class repair during the twenty-five-year period. The City Commission reserves the power of making and regulating the rates for water and electric lighting. One of the important features of the project is the large lake that the dam will create, which the city plans to make one of the greatest pleasure resorts in the South. The contract stipulates that the lake shall belong to the city of Austin. Besides the dam and hydroelectric plant, the contractor must construct a water-storage reservoir of 10,000,000-gal. capacity for the purpose of keeping on hand a reserve supply for the use of the city, and must also install pumps to keep this reservoir full. The works must all be finished within two years. Preliminary construction work has already been started, and it is stated by Mr. Johnson that the entire works will be finished within one year.

Los Angeles Aqueduct Hydroelectric Project.

In a communication to the Public Service Commission of Los Angeles dated Aug. 23 Mr. E. F. Scattergood, chief electrical engineer of the Los Angeles Aqueduct Commission, notes that the board of public works, with the approval of the Public Service Commission, has determined that the initial generating station for the development of hydroelectric power on the Los Angeles aqueduct shall consist of a partial development at the San Francisquito No. 1 power site, consisting of three generating units with a total rate capacity of 30,000 hp and peak-load capacity of 37,500 hp, together with the necessary transmission lines and a terminal station in the city. The power site is located on the aqueduct about 47 miles north of Los Angeles.

Specifications for the main power-house equipment, consisting of waterwheels, generators and transformers, are already prepared and as soon as they can be printed will be advertised. Bids will be received up to about Oct. 20. In the absence of unforeseen delays the engineer reports that the generating station should be ready for operation at the end of December of next year, at which time it is understood the aqueduct will be in operation.

Mr. Scattergood asks that provision be made for the distribution of this electrical energy in the city of Los Angeles. He appears to favor municipal ownership rather than selling the energy at wholesale to existing electric-service companies. The city electrician also asks the city to formulate a policy, as the matter of street lighting is involved.

Workmen's Compensation for Injuries in Electrical Lighting and Power Companies.

By R. S. Hale.

Bulletin No. 90 of the Bureau of Labor for September, 1910, gives considerable information on the subject of workmen's compensation for injuries in various countries and for numerous businesses, including "electrical lighting and power establishments."

The laws in the different countries differ very largely in details, so largely that a complete analysis would be impracticable, but the following is a general outline.

There are four chief items that are of interest, namely: (1) The payments in case of death; (2) the payments in case of disability; (3) the waiting period after the accident before payments begin; (4) the rate or cost expressed as percentage of the payroll.

Below I give these items for the different countries with notes that will bring out certain interesting points.

STATISTICS OF WORKMEN'S COMPENSATION IN VARIOUS COUNTRIES.

	Death Benefit.	Disability Benefit.	Waiting Period.	Expense.	
Austria	Pensions of 50 per cent of wages to dependents.	60 per cent of wages during disability.	4 weeks	1.8 per cent	Average of mutual associations.
Denmark	Four years' wages	60 per cent of wages during disability, but not exceeding full wages for six years	13 weeks	2.4 "	Stock company.
				2.9 "	Mutual company.
Denmark	Four years' wages	60 per cent of wages during disability, but not exceeding full wages for six years.	None	3.33 "	Stock company.
Finland	Pensions of 40 per cent of wages to dependents.	60 per cent of wages during disability.	6 days	1.5 "	Average of a stock company and a mutual company.
France	Pensions of 60 per cent of wages to dependents.	66⅔ per cent of wages during disability	4 days	5.5 "	Stock company.
Germany	Pensions of 60 per cent of wages to dependents.	66⅔ per cent of wages during disability	13 weeks	1.32 "	Average of mutual associations including expenses.
Great Britain	Three years' wages	50 per cent of wages during disability	1 week	1 to 1.5 per cent	Stock companies.
Italy	Five years' wages	50 per cent of wages during disability, but not exceeding full wages for six years.	None	2.6 per cent	Government Insurance Department.
Netherlands	Pensions of 60 per cent of wages to dependents.	70 per cent of wages during disability.	1 day	2.4 "	Government Insurance Department.
Norway	Pensions of 50 per cent of wages to dependents.	70 per cent of wages during disability.	4 weeks	1.34 to 2.23 per cent	Government Insurance Department has been charging premium of 1.34 per cent, but reports average cost 2.23 per cent, which means that the rate will probably be raised shortly.
Quebec	Four years' wages	50 per cent o wages during disability.	7 days	3.75 to 6.75 per cent	Stock companies.
British Columbia	Three years' wages	50 per cent of wages during disability.	2 weeks	2.55 to 4.05 per cent	Stock companies.
Sweden	Pensions of 66⅔ per cent of wages to dependents.	66⅔ per cent of wages during disability	60 days	1.06 to 1.33 per cent	Stock and mutual companies.
Sweden	Pensions of 66⅔ per cent of wages to dependents.	66⅔ per cent of wages during disability	3 days	1.73 per cent	This is the company that charges 1.33 per cent for waiting period of sixty days
New York	Four years' wages	50 per cent of wages during disability; but not exceeding full wages for four years	2 weeks	7 "	Stock companies.

In practically all cases the laws provide for compensation for all accidents except those arising from the negligence or gross misconduct of the employee, but do not provide for ordinary sickness not incident to the employment.

Occasionally there is provision for increasing the compensation in case of the employer's gross fault. In practically all cases the laws provide for partial compensation in case of partial disability and for a small sum for funeral expenses. In a few cases there is a provision for payment for medical attendance in cases of disability not resulting in death.

In practically all cases the laws provide for certain maxima and minima payments; for instance, that if the wages exceed a certain amount the payments shall be figured on that amount only, or that only some small fraction of the wages over that amount shall be considered, and, similarly, that the minimum payment shall not be less than a certain amount. These limits, however, are probably wide enough to include the great majority of employees.

In some cases the "waiting period" refers to an absolute waiting period for which no payments are made; in other cases only to a period before which no payments are made, but if the disability continues the payments cover the whole time.

In some cases there are several figures for benefit payments, according to circumstances. I have given a single figure that would express the result as simply as practicable without encumbering the statement with details.

The cost figures given are, in some cases, averages of the net figures for a period of years, and in other cases are the rates quoted by the companies offering insurance. As in the case of the benefit payments, I have made a simple statement in order to avoid cumbersome details.

In Quebec and New York the high rates of the stock companies are probably due to the fact that the laws were only recently enacted (in 1910). In British Columbia, where the statute (of 1903) is substantially the same, and if anything more severe, the rates quoted are distinctly lower. The reports of the experience of the New York Edison Company point to the same conclusion that these rates will come down, although the New York Edison Company, like the English electrical companies, would naturally show a low figure on account of the absence of overhead lines.

SUMMARY.

The ordinary death benefit appears to be either a pension of 50 per cent of the wages to the dependents—that is, widow or children—while they remain such, or about four years' full wages as a single payment.

The ordinary disability benefit appears to be 50 per cent to 60 per cent of wages during disability, reduced, of course, for partial disability.

The ordinary waiting period, excluding, as in Germany, cases where there are sickness insurance societies that take care of the first portion of the disability period, appears to be about a week, with, however, wider variations than in the case of the payments.

The cost when the schemes get in full swing so that full actuarial reserve is provided, and when the companies get down to a normal basis, appears to be from 1.5 per cent to 3 per cent of the payroll.

The actual cost will, of course, vary with the amounts of the benefits provided, with the waiting period required and with other circumstances not considered here, as for instance, the proportion of overhead lines or the efficiency of administration or leniency of arbitrators to those injured.

I think that the above gives a good general outline of the situation and of the costs (as reported in the government bulletin) for electric light and power establishments.

Maryland Commission News.

Mr. James E. Alfred, president of the Consolidated Gas, Electric & Power Company, and Charles M. Cohn, vice-president and general manager of the company, called on the Public Service Commission last week to give notice of a possible request for an extension of the time within which the company is required to answer certain questions put to it by the commission in connection with the complaints of the city against the present rates for gas and electricity. Mr. Aldred told Messrs. Laird and Hering of the commission that, despite the strenuous efforts that were made by the company to supply answers by time, it had found the work harder than had been anticipated, and that it might be necessary to ask for an extension. Dr. Hering said that he should prefer to have from the company as complete a case from its viewpoint as it can make, so that the result of the hearing may be more or less permanent.

The commission has signed an order authorizing the Susquehanna Transmission Company to issue stock to the amount of $1,031,000. The revenue from the sale of the stock will be used to reimburse the Pennsylvania Water and Power Company, which advanced the sum to the transmission company.

Massachusetts Commission News.

The Tyngsborough (Mass) Electric Light Company recently petitioned for approval of an issue of new capital stock of the par value of $7,500. This company was organized in 1909, and up to the present time has not owned or operated any electric-light plant. It has never issued any of the stock authorized, which was $3,000. A partnership consisting of Messrs. A. A. Flint and A. L. Derby, having built a generating plant and distributing system, has been carrying on the business of making and selling electricity in the towns of Tyngsborough and Dunstable, Mass., for about a year and a half. The members of this partnership are among the incorporators of the Tyngsborough Electric Light Company. The purpose of the proposed stock issue is to enable the corporation to purchase all the property of the partnership used in the electric-light business and to continue the business.

From evidence brought out at the hearing it appeared to the Massachusetts Gas and Electric Light Commissioners that the property will fairly represent the capital stock asked for. The board says in its decision that the $3,000 capital stock must first be issued so as to enable the stockholders to vote to increase the stock to the full amount of $7,500.

The board has approved the issue of $7,500, in 300 shares at $25 per share, the proceeds to be applied to the purchase of the property of Messrs. Flint and Derby. Shares remaining unsubscribed for by stockholders entitled to take them shall be offered for sale in Boston.

The Massachusetts Gas and Electric Light Commissioners have approved the joint application of the Beverly Gas & Electric Company and the Danvers Gas Light Company for consolidation under the name of the Beverly Gas & Electric Company. The Beverly company supplies gas in Beverly and electricity in the towns of Wenham, Topsfield and Hamilton, as well as the city of Beverly. It was authorized in 1889 to engage in the business of selling electricity in the town of Danvers, but never has exercised the right. The town of Danvers in 1889 established a municipal electric lighting plant and by consolidation the Beverly company acquires all the rights the Danvers company has now, but will not gain any new rights as against the Danvers municipal plant; before it can engage in supplying electricity in Danvers authority must be obtained from the Selectmen of that town for location of lines in the public streets.

The Danvers company sells gas only in the town of Danvers, which is a municipality contiguous to Beverly. It was organized in 1861 with a capital of $20,000, which was increased to $30,000 in 1909. On June 1, 1911, it had a plant with a book value of about $50,000 and other assets of about $2,350. It owed $7,433. It paid dividends in only five years between 1885 and 1906. In the latter year it paid 3 per cent, in the following three years 6 per cent, in the last two years 6½ per cent. Since 1903 the company has been owned or controlled by the same interests as those

controlling the Beverly Gas & Electric Company. The plants have been physically connected and in all essentials operated as one plant. With the approval of consolidation the price of gas will be reduced in Danvers from $1.70 to $1.40 net per 1000 cu. ft. The Danvers company conveys to the Beverly company all its property and franchises and the latter assumes all the liabilities and obligations of the Danvers company. The Beverly company is authorized to issue 300 shares of stock of $100 par value in exchange for the 600 outstanding shares of the par value of $50 each of the Danvers company.

By an order simultaneously adopted the Beverly Gas & Electric Company is authorized to issue 1216 new shares at $170 per share, the proceeds of sixty-nine shares to retire 118 special shares now out and the proceeds of 1147 shares to pay for additions and improvements to the plant subsequent to January, 1911.

President Sidney W. Winslow, of the United Shoe Machinery Company, is president of the Beverly Gas & Electric Company.

CURRENT NEWS AND NOTES.

CANDLE-POWER OF ELECTRIC SIGNS.—The city of Chico, Cal., has passed an ordinance providing that electric signs must contain less than the equivalent of one 16-cp light to 1 sq. ft. of sign surface.

* * *

PASADENA (CAL.) MUNICIPAL PLANT.—The annual report of the Pasadena (Cal.) municipal lighting plant, which was established at an initial cost of $200,000, gives the revenue for the fiscal year ending July 30, 1911, as $110,900.71. Of this total $70,268.20 represents the sale of electricity for commercial purposes at a lighting rate of 5 cents per kw-hour.

* * *

ELECTRICAL ENGINEERING AT UNIVERSITY OF LOUISVILLE.—The University of Louisville has equipped a building for engineering courses, including electrical engineering, and instruction in these departments will commence this fall. Prof. W. M. Anderson is in charge of the course in electricity.

* * *

GROWTH OF THE AUTOMATIC TELEPHONE IN CHICAGO.—President Frisbie, of the Illinois Tunnel Company, in a statement this week said that his company has now over 23,000 automatic telephones in active operation and 37,000 other subscribers awaiting installation, and that by Oct. 1 service will be opened to St. Louis, Bloomington, Springfield, Peoria, Indianapolis and intermediate points.

* * *

ELECTRIFICATION OF SWISS RAILWAYS.—The commission which since 1904 has been studying the subject of the electrification of all Swiss federal railroads, which aggregate a length of 1830 miles, has recommended the adoption of the single-phase system, with overhead construction instead of third-rail. It is estimated that there will be a saving from electric traction of about 10 per cent. The first line to be electrified is the St. Gothard railway.

* * *

OHIO CENTRAL-STATION LOVING CUP.—The Duncan Electric Manufacturing Company, of Lafayette, Ind., presented a handsome loving cup to the winning baseball team at the recent convention of the Ohio Electric Light Association held at Cedar Point, Ohio. The cup was won by the central-station men's team and the name of each player is engraved on one side of the cup. It is the intention to exhibit the cup in the offices of the different players, each man to have the cup for a certain length of time.

* * *

OUTING OF WESTERN ELECTRIC COMPANY'S TELEPHONE DEPARTMENT.—The tenth annual outing of the telephone engineering department of the Western Electric Company was held at Ravinia Park, Ill., Aug. 19. A special train over the Chicago & Northwestern Railroad conveyed the party to the park, where baseball and track games were held, followed by a dinner in the open. A symphony concert concluded the day's pleasures, after which the party boarded the special for Chicago again.

* * *

COMMONWEALTH EDISON COMPANY PURCHASES LAND AT QUARRY STREET.—The Commonwealth Edison Company of Chicago has purchased for $81,250 about 2⅔ acres of land fronting on Quarry Street, the South Branch of the Chicago River, Evans Slip and the Chicago & Alton Railroad. It is part of the site of the large Quarry Street generating station and was formerly held under long lease from the trustees of the Northwestern University, but the company has now purchased the fee.

* * *

ELECTRIC LIGHTING IN RUSSIA.—There are only sixty-two central stations in European Russia. On the other hand, St. Petersburg has the largest number of incandescent lamps in use in proportion to population of any city in Europe, being 440 per 1000 as compared with 240 for Vienna, 185 for Paris, 184 for London and 176 for Berlin. The corresponding figure for the Borough of Manhattan, New York, is over 2000, and for Brooklyn over 1000. The rates per kw-hour in Russia vary from 12½ cents for Kiel to 16½ cents for St. Petersburg and 25 cents for Moscow.

* * *

VERMONT ELECTRICAL ASSOCIATION.—The Vermont Electrical Association will hold its annual meeting at Lake Dunmore, near Rutland, Vt., on Wednesday and Thursday, Sept. 13 and 14. The executive session will be held on Wednesday morning at 10:30 a. m; at 3 p. m. there will be a session for the reading and discussion of papers and in the evening a banquet and smoker. The second day there will be a ball game between the supply men and the central-station men, and the rest of the day will be devoted to trips to points of interest about the lake. Prof. W. L. Upson, of the University of Vermont, will deliver an address at a session on Wednesday afternoon at which one paper will also be presented.

* * *

SEATTLE MUNICIPAL CENTRAL STATION.—In a recent address Mayor Dilling of Seattle spoke of the growth of the municipal lighting system of his city, which to date represents an investment of $3,360,000. He said that on Aug. 1, from records of the superintendent, the city had 15,736 customers, 20,000 poles, 20,000 miles of wire, 921 street arc lamps, 5130 street incandescent lamps and 1398 poles with cluster lights carrying from one to five lamps each. The earnings of the system for the year 1910 totaled $598,500, while the revenue for the current year is estimated at $800,000. An election on Sept. 5 authorized a bond issue of $1,000,000 for the extension of the lighting system, which will enable the capacity of the plant to be increased from 14,000 hp to 90,000 hp.

* * *

SAN BERNARDINO A DOUBLY LIGHTED CITY.—The contract for lighting the streets of San Bernardino, Cal., has heretofore been held by the Lytle Creek Light and Power Company, the officials of which understood that their agreement continued in force until Sept. 1. The new contract for the next year, obtained by the Pacific Light & Power Company, was scheduled to go into effect Aug. 1. When the Pacific company installed its service on this date the Lytle Creek officials refused to turn off their lamps until Sept. 1. As the result, the city enjoyed a double illumination of its streets until the middle of August, when the municipal officials ordered the Lytle Creek company to discontinue service. The company will demand payment for the entire month of August.

Commonwealth Edison Section of N. E. L. A.—The Commonwealth Edison Section of the National Electric Light Association will hold its first meeting after the summer intermission at Handel Hall, Randolph Street and Wabash Avenue, Chicago, on Tuesday evening, Sept. 5.

* * *

Indiana Central Stations.—According to a map of the electric-lighting plants in Indiana, exhibited by Secretary J. V. Zartman, of the Indiana Electric Light Association, at the association's recent South Bend convention, there are 265 central stations in the State. Of these 191 are privately owned and seventy-four are municipal plants.

* * *

American Electric Fan for British Queen.—An American manufacturer has furnished an electric fan for Queen Mary of Great Britain, which will be used for the purpose of drying her hair. It is mounted in gold and has an ebony switch, and was designed to harmonize with the appointments of Her Majesty's boudoir. It is said to be the most costly electric fan ever manufactured in America.

* * *

Hertzian-Wave Fog Signals.—The French government has ordered the establishment of three stations along the coast of France from which to transmit Hertzian-wave fog signals. Each station will emit a distinctive telephone note every 30 seconds, and repeat during 10 seconds a letter of the Morse telegraph code. The telephone notes selected for the three stations correspond to given wave-lengths or frequencies.

* * *

Gasoline Trucks Not Allowed on Steamship Piers.—The gasoline-truck interests have not yet been able to secure admission of gasoline cars on the piers of large steamship lines, notwithstanding strong effort on their part. Representatives of some of the foreign lines state positively that consent will not be given under any circumstances, while others plead the operation of insurance rules. There is, of course, no objection to electric trucks.

* * *

Annual Outing of Employees of Goulds Manufacturing Company.—The annual outing of the employees of the Goulds Manufacturing Company, Seneca Falls, N. Y., was held at Cayuga Lake Park on Aug. 23. Aquatic and track sports occupied the time of the picnickers, who numbered close on to 2000. The outing was the first given by the company and it is the intention of the management to continue them as a means of cementing their organizations more closely.

* * *

Electricity in Textile Mills.—The backward state of industrial electricity in Great Britain is indicated by the appointment by the British Textile Institute and the Institute of Electrical Engineers of a joint committee to conduct an investigation on the application of electricity in textile mills. Apparently knowledge of the great progress in this country in the utilization of the electric drive in such mills, which dates from about 1894, has not penetrated to the British Isles.

* * *

Electricity Brought to a Head.—In a popular-magazine article relating to a controversy in one of the government departments it is stated that the facts were brought out in testimony before a Congressional committee. This statement is followed by the sentence: "Now the electricity engendered by all this friction has come to a head." This figure of speech would seem to belong to what the rhetoricians style mixed metaphors. The conception of electricity coming to a head, like a boil, is curious.

* * *

Fire Losses and the Careless Use of Matches.—Of 3875 known causes of fire in Chicago in 1910 1089 were due to the careless use of matches. For the United States and Canada fire losses the first six months of this year totaled $129,000,000, compared with $99,000,000 for the same period last year. Since during the latter half of 1910 the heaviest losses occurred, the total fire loss for 1911 is expected to be $260,000,000. These losses added to the cost of fire prevention total $450,000,000 annually, and represent one-half the value of all new buildings erected in the year. The annual per capita fire waste in Europe averages $0.33 and in the United States $2.51.

* * *

International Congress of Applied Chemistry.—The eighth International Congress of Applied Chemistry is being held in Washington Sept. 4-13, 1912. The organizing committee includes the president, past-presidents and secretary of the American Electrochemical Society and the president of the American Institute of Electrical Engineers, and among members of the executive committee are Drs. E. G. Acheson, W. D. Bancroft and L. H. Baekeland. One of the sections will deal with india rubber and other plastics, another with electrochemistry and a third with physical chemistry, while conservation of natural resources will divide a section with political economy. Prof. C. F. Burgess is vice-president, and Dr. E. F. Roeber secretary of the section on electrochemistry, and Dr. W. R. Whitney is president of the section on physical chemistry, to which Dr. G. A. Hulett, of Princeton, is attached.

* * *

Lighting of Elevated-Railway Crossing Subways in Chicago.—In a recent communication Mr. William Carroll, city electrician of Chicago, declares that none of the street-crossing subways under elevated-railroad tracks in Chicago is properly lighted. There is a dispute between the railroad companies and the city as to who should light these subways, and a test case is now in the courts. In the meantime, Mr. McGann, the commissioner of public works of Chicago, has caused to be formed a commission consisting of an electrical engineer from each railroad company affected, the electrical engineer of the Sanitary District and the city electrician to formulate a comprehensive plan for the electric lighting of steam railroad grade crossings and subway crossings. The plan proposed by the city electrician and approved by the commissioner of public works provides for one 16-cp lamp for each 400 sq. ft. of street surface to be lighted and contemplates the removal of all arc lamps and high-potential wires from the crossing subways.

* * *

Ottawa Lighting Rates.—At a meeting of the directors of the Ottawa Power Company (Canada) an announcement was made that the company would give consumers, commencing Sept. 1, the choice of two things—either to make contracts with the company for lighting at the present rates offered by the company or at the same rate now charged by the commission of the municipal lighting plant. The Ottawa Electric Company now supplies 17,000 customers, but as the announcement applies to domestic lighting only, and not to commercial premises, about 12,000 homes will be affected. Mr. A. A. Dion, manager of the Ottawa Electric Company, announced that the new rates of the municipal plant will be copied, but the old rates will remain in force until the customers of the company come and request to make new contracts with the Ottawa Electric at the municipal plant's prices, which come into effect on Oct. 1. If any reduction is made in the latter plant's rates the customers of the company will be given the benefit of the reduction. According to Mr. Dion, the reduction in the municipal rates will not mean anything to the individual customer, although the city officials claim that their revised scale will secure a reduction of 12 per cent to 25 per cent on an average.

NEW HIGH-TENSION TRANSMISSION SYSTEM IN CONNECTICUT VALLEY.

AN important addition to the high-tension electric transmission system of New England has been in operation for about a year in the Connecticut Valley district of Massachusetts under the management of the Easthampton Gas Company and the Amherst Power Company. The enterprise includes the introduction of hydroelectric service into the Amherst, Easthampton and Mount Tom districts and the construction of an auxiliary steam turbine generating station and substation at Mount Tom Junction, from which facilities for power distribution throughout a wide area are available. A conspicuous feature of the work is the operation of a steel-tower transmission line 8.5 miles in length between Amherst and Mount Tom, the line delivering energy purchased from the Turner's Falls Power Company at 23,000 volts to the Easthampton Gas Company. The construction work of the enterprise has been handled by the local companies under the direction of Mr. H. M. Turner, supervising engineer, and the consulting engineer of the undertaking is Mr. N. J. Neall, of Boston, Mass., formerly of the firm of Thomas & Neall, New York and Boston.

Prior to the establishment of the Mount Tom generating station and substation and completion of the steel-tower line from that point to Amherst energy was transmitted from the Turner's Falls plant to Amherst by a three-phase circuit carried on a wooden-pole line, the distance being 18 miles. This line has been retained in the new development, the extension to Mount Tom Junction being carried on steel towers. The line has been designed for ultimate operation at a potential of 66,000 volts. The auxiliary turbine plant at Mount Tom Junction was installed in order to insure absolutely continuous service of adequate capacity, the amount of power available at Turner's Falls being somewhat limited in view of the industrial possibilities of the Easthampton region.

The transmission line between Amherst and Mount Tom consists of ninety-three steel towers of the so-called Rockingham type and two river towers carrying the line across the Connecticut River at Mount Tom to the generating station of the Easthampton Company, the latter being located on the west bank of the stream and connected with the local centers of distribution by a 4600-volt, three-phase service.

In the construction of the transmission line nine dead-end towers, five towers with 7-ft. extensions, one tower with a 14-ft. extension, and seventy-six standard towers were erected. One mile of pole line was built to connect the steel tower line with the old line in Amherst, and the 4600-volt service from Mount Tom station to Easthampton is 4 miles in length, wooden-pole construction being followed throughout.

Fig. 2—Method of Placing Steel Tower Anchors.

The standard tower consists of an A-frame built of steel angles, the structure being 12 ft. square at the bottom and about 50 ft. high. In general, the vertical members are built of 3-in. x 3-in. x 3/16-in. angles, the horizontal members being as a rule of 2-in. x 2-in. x ⅛-in. angles, and the diagonal bracing 1½-in. x 1½-in. x ⅛-in. angles at the bottom and ½-in. round rods in the balance. The standard tower is built in seven vertical sections varying in height from 8 ft. to 6 ft. 2½ in., and the tops are approximately 7 ft. in width. The standard height of the nearest conductor to the ground is 45 ft. 1 in. Each tower

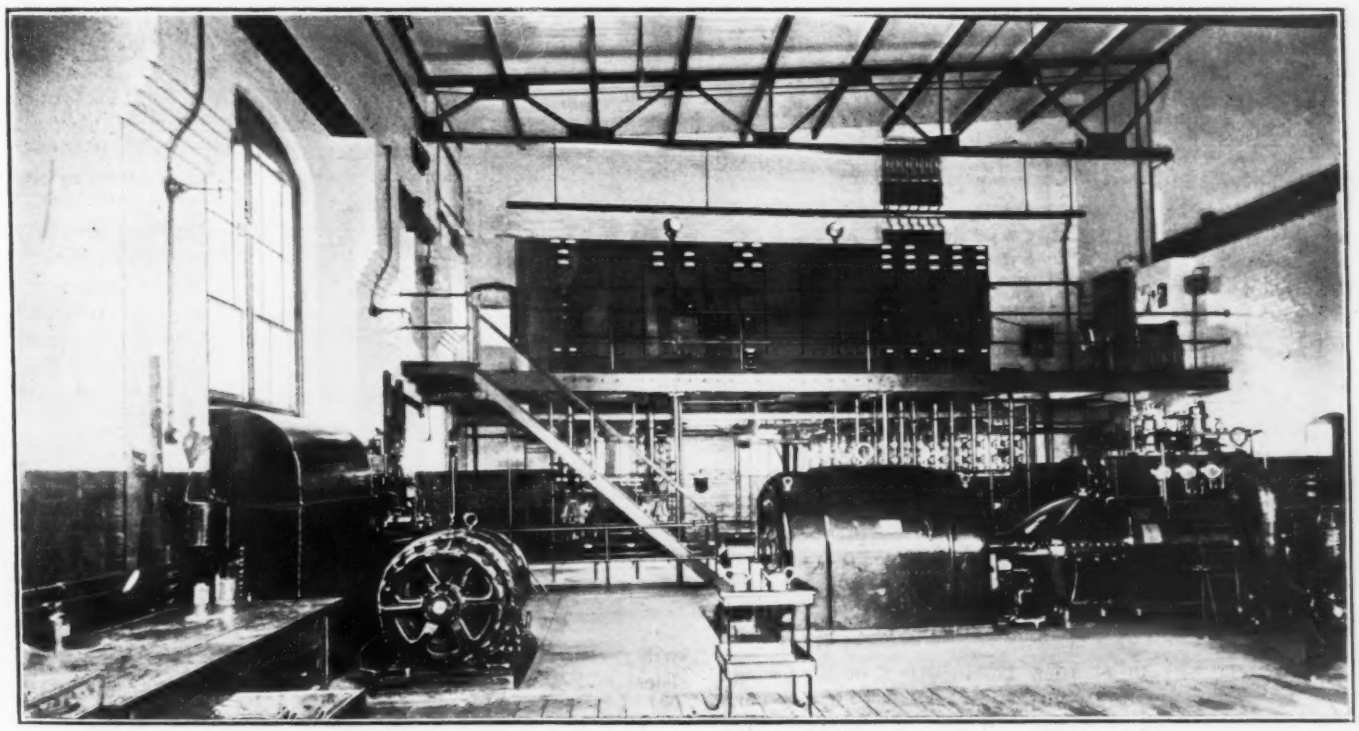


Fig. 1—Interior of Easthampton Power Station.

is surmounted by a ¾-in. pipe 4.5 ft. long, carrying three ⅜-in. round rod lightning projections 2 ft. in length. A 7/16-in. steel ground wire is also carried from tower to tower above the transmission wires. The standard span

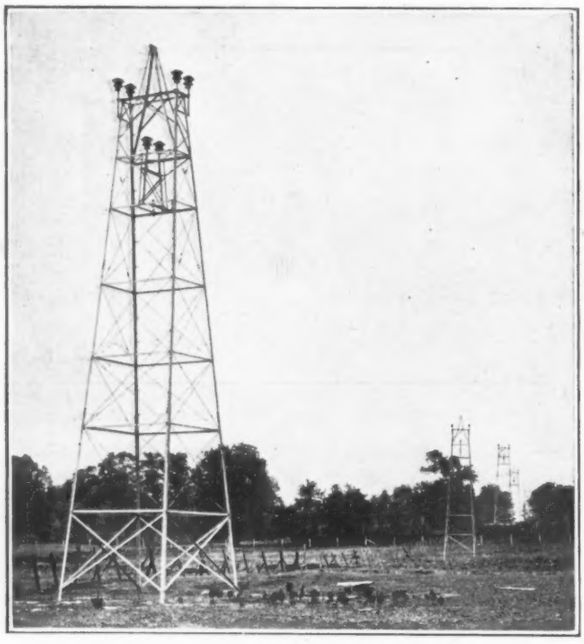


Fig. 3—Transmission Line with Dead-End Tower in Foreground.

between towers is 500 ft., and the maximum span, at the Connecticut River crossing, is 1200 ft. The line wire is seven-strand No. 2 B. & S. copper cable carried on quadruple-petticoated Thomas porcelain insulators 14⅞ in. in height, which are spaced on a 6-ft. 10½-in. equilateral triangle.

The towers are anchored in concrete or earth foundations, according to the nature of the soil encountered. The towers were assembled on the ground, rights of tower location having been purchased from landowners. They were erected by the use of gin poles, a force of twelve men usually being required. The maximum number of towers erected in a single day was fourteen, the contractors for this work being Messrs. Fred T. Ley & Company, Springfield, Mass. The tower anchors were located by the use of adjustable templates built of angle irons and round rods, as shown in the accompanying illustration. In the location of the anchors holes were first excavated at the approximate corners of the tower. Planks were then laid across the holes in a diagonal fashion and the template was lined up against the timbers and leveled. The anchors were then attached to the template at the corners and the holes backfilled or concreted. The templates were then removed and the towers attached to the anchors.

The dead-end towers are provided with slightly heavier angles than the standard structures and are also equipped with two pins, one on each side of the tower, carrying each phase wire. Two transpositions were made in the line between Mount Tom and Amherst. All joints in the wires were made with McIntyre connectors and a telephone circuit of ¼-in. steel wire is carried on the towers about 10 ft. below the transmission circuit and transposed at every tower. The insulators are carried on pins composed of 2-in. extra heavy pipe. On account of the variations in the height of the water in the Connecticut Valley, particularly in the lowlands bordering the river near the crossing of the line from the east to the west bank, the towers near the shore are provided with a foundation facing of concrete 5 ft. in height to protect the structure from floating ice.

The river crossing is supported by two dead-end towers carrying the conductors 60 ft. above the ground, the base of the tower being 18 ft. square in each case. In place of copper the span across the river consists of three special Siemens-Martin steel cables ½ in. in diameter each. The cables were cut to length and pulled to the proper sag by the use of turnbuckles, the construction being shown in the accompanying drawing. The top of each river crossing tower is equipped with an angle-iron framework carrying four insulators in a single row for each phase wire, but in place of the wire the insulators carry a steel plate clamped to their tops, the plate tying the four insulators together in each phase and being provided at each end with a turnbuckle 18 in. in length to which the phase cable is clamped.

The insulators are spaced 2 ft. 8 in. apart in seriatim and the supporting strap is supplemented by carrying the conducting steel cable to approximately the middle point, joining the cable to the No. 2 line wire by a Dossert connector. The strap is 4 in. wide and ½ in. thick and is bolted to the clamps which surround the insulator heads, as shown in the accompanying photograph made before the copper and steel line wires were joined. Each river tower is equipped with a grounding bar installed on each side of the structure and the conductors are each tied into the tower by three strain insulators, so that in case of a break in the line at the tower the phase in trouble will immediately be grounded.

The standard attachment to the insulator employed on the line is shown herewith, and it consists of a double helical tie of No. 4 copper on each side of the insulator, making two pairs of loops around the insulator cap. The main conducting wire is carried across the top of the insulator through a porcelain bushing, and just outside the bushing on each side the helical tying is begun and continued for a distance of 6 in., the end on each side being carried completely around the groove in the insulator head and continued down the phase wire away from the insulator for 6 in. more, so that the total length of tie wire is 12 in. on each side of the insulator.

The generating plant and substation at Mount Tom is a structure of brick, concrete and steel located beside a spur track of the Boston & Maine Railroad and within about a hundred yards of the river. The generating station proper is about 90 ft. long by 70 ft. in width and at the east end of the building is located a substation or transformer room 40 ft. x 25 ft. in plan. A boiler room 67.5 ft. x 47 ft. and a turbine room 57.5 ft. x 40 ft. in dimensions divide the power plant into two fireproof sections, temporary walls being left on the north side of the station to

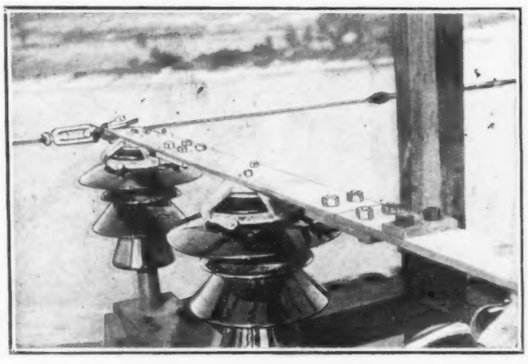


Fig. 4—Mechanical Connector at River Crossing.

provide for future increases in capacity. Beneath the boiler and turbine rooms is a basement about 20 ft. high containing condensing and pumping equipment, turbine foundations and piping. The transformer house is built in

two stories with a 7.5-ft. basement containing a tank and piping for cooling water service.

Coal is brought to the plant by rail and delivered into a temporary storage bin at the west of the boiler room, provision for weighing it in hand barrows being made in front of the furnaces. Two 350-hp Heine water-tube boilers furnish the steam supply, these being operated at 160 lb. without superheating. The exhaust gases of the boilers discharge through short tapering uptakes into a breeching leading to a Custodis radial brick stack 145 ft. high and 8.5 ft. in inside diameter. The stack foundations are carried down to bed rock at a depth of 12 ft., the base of the foundation being 17 ft. square. In general the station foundations are carried to bed rock, piles being used only in cases where the rock was over 12 ft. below the surface of the ground, and the basement walls are thoroughly waterproofed. Where piles are used they are capped with concrete reinforced by old steel rails to prevent any cracking of the foundation where the concrete rests on the rock in case of pile settlement. Outside walls are of brick, the thickness being 16 in. The boiler house and turbine room are provided with a concrete roof supported on steel trusses and the transformer house is furnished with a similar roof carried on steel I-beams.

Water for boiler-feed and condensing service is drawn from the Connecticut River by a 12-in. x 15-in. x 15-in. Worthington duplex low-service steam pump, there being a 14-in. pipe 700 ft. in length between the stream and a well located just without the turbine-room doorway. The pipe connections provide for the delivery of feed water to a 1500-hp National closed heater which raises the temperature to 200 deg. Fahr. before the water enters the boilers. The heater is by-passed and it delivers water to a 6-in. feed main running along the boiler fronts, from which risers lead to the steam generating units. From the boilers 6-in. steam delivery outlets connect with a 15-in. header from which branches lead to the turbine and auxiliary apparatus. A 10-in. x 6-in. x 10-in. Warren feed pump handles the boiler water supply.

The present generating unit consists of a 1000-kva Westinghouse turbo-alternator delivering three-phase, 60-cycle energy to the busbars of the station at 4600 volts, the turbine being of the three-stage type, with a normal speed of 3800 r.p.m. It operates on a vacuum of 29 in. and the governor is equipped with a motor control for the purpose of synchronizing the machine more readily with the incoming service from Amherst. The speed can be varied

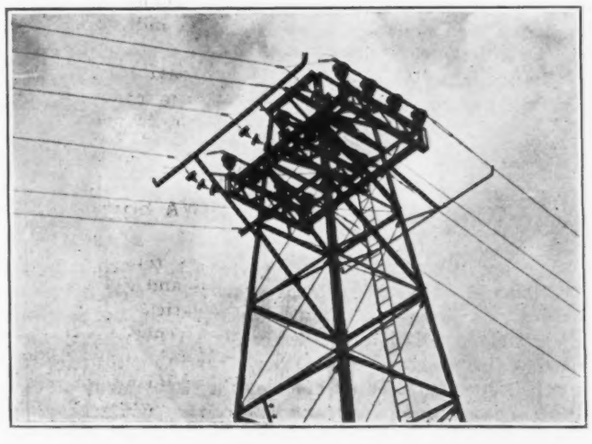


Fig. 5—River-Crossing Tower.

about 200 r.p.m. by the governor control, which is operated by a 1/10-hp, 125-volt Westinghouse direct-current motor. Energy for this machine and for the alternator fields is supplied by two exciters, one being a 50-kw machine direct-driven by a 75-hp, 440-volt induction motor running at 2500 r.p.m. and the other a 50-kw turbo-exciter running at 2250 r.p.m. The latter machine is equipped with fan cooling apparatus and the generator winding is of the

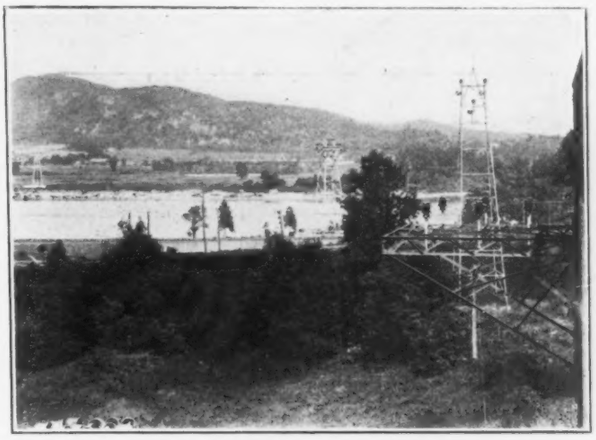


Fig. 6—Transmission Line Crossing River.

interpole type. The turbine is provided with a supply of air for cooling the generator through a duct carried under the floor from an opening in the north wall of the building. The turbine exhausts into a Westinghouse LeBlanc condenser located directly under the unit in the basement. The condenser is provided with an 8-in. discharge line to the river and takes injection through a 10-in. line connecting with the exterior well above mentioned. For starting the unit water for injection can be drawn from a tank located on the power-house roof, a 6-in. lead connecting with the condenser. The condenser air pump is driven by a Westinghouse steam turbine, which is operated at 1500 r.p.m.

Condensation from the local steam-heating system of the plant, which is served by the boilers through a reducing valve, is collected in a 200-gal. tank in the basement and thence returned to the boilers via the feed pump and heater. Other auxiliaries located in the basement include a 3-in. x 2-in. x 3-in. duplex turbine oil pump; a centrifugal sump pump driven by a 2-hp motor controlled by float switch, and two Kenney centrifugal pumps drawing water from eight driven wells for general plant service, each pump being driven by a 5-hp, 110-volt General Electric induction motor running at 1800 r.p.m. The motor starter for the roof-tank service is located on the switchboard gallery in

REPRESENTATIVE CONSTRUCTION COSTS, STEEL-TOWER LINE.

(8.5 MILES.)

	Cost per Tower	Per Mile.
Haulage, all line materials	$8.90	$97.00
Haulage of towers only	4.28	46.80
Haulage, anchors only	.16	1.72
Setting anchors	3.38	37.00
Excavation	6.91	75.50
Stringing wire	13.25	145.00
Tower assembling	8.20	90.00
Tower erection	6.10	66.60
Tower protection against ice	8.34	98.00
Total cost of labor per tower, excluding contractor's profit	70.50	772.00
Right-of-way	124.00	1,155.00
Engineering, including preliminary surveys	16.10	....
Overhead expenses, general	21.80	....
Cost of material for line, $18,212; per tower, $196; per mile, $2,140.	....	....
Cost of one river tower in place, $1375.	....	....
Total cost of material and labor complete river span, $3,258.	....	....

the turbine room and mechanically connected to a float switch in the tank. The general service pumps are directly piped to the roof tank. The turbine room is served by an 8-ton Maris crane and a "Peerless" hoist of the same capacity is installed in the transformer room.

The incoming phase wires from the Amherst power

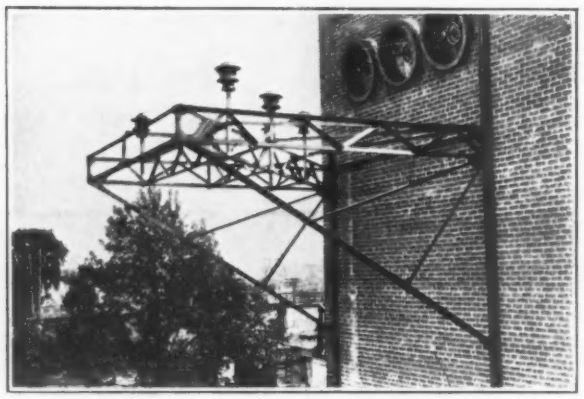


Fig. 7—66,000-Volt Entrance Bracket.

system are brought into the substation through 36-in. Akron pipe bushings and after passing through disconnecting knife switches and choke coils the leads terminate in three 66,000-volt solenoid-operated oil switches located on the second floor of the substation. From this point the leads drop to the high-tension terminals of three 500-kw Westinghouse transformers of the water-cooled type, located on the ground floor of the building. These reduce the potential from 22,000 volts to 4600 volts and deliver energy to a busbar installation in the turbine room which is arranged to permit the separate operation of the steam and hydro-electric service if desired, although normally the two services are handled in multiple. The switchboard is mounted

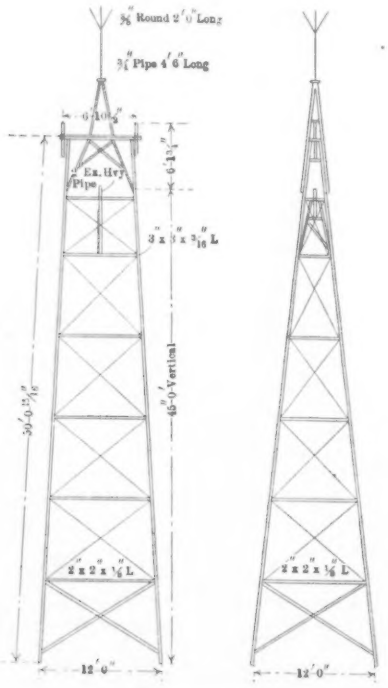


Fig. 8—Standard Type of Tower.

10 ft. above the floor of the turbine room. It is of the remote-control type, energy being supplied for the operation of solenoid oil switches by the turbine exciter units. The height of the turbine room is 28 ft. and in the section directly below the switchboard are located the oil switches controlling the 4600-volt distribution and bus circuits of the system. The transformer house is 51 ft. in height and it is connected with the bus structure in the turbine-room by cables run in conduit. The high-tension conductors enter the substation from the steel tower line with a spacing of 48 in. apart on centers. The substation is separated from the generating plant by fireproof doors and the second floor is reached by an iron stairway.

The switchboard is located on a reinforced concrete gallery and contains sixteen panels controlling the various machines, high and medium tension switches. The usual

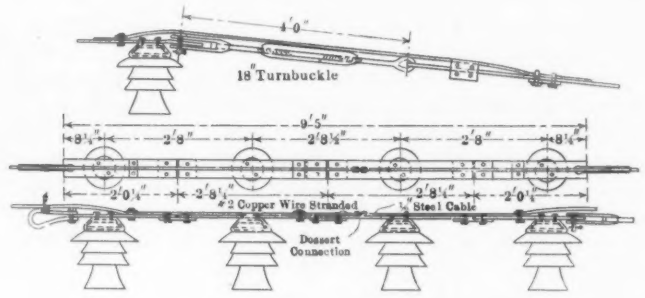


Fig. 9—Conductor Attachment at River-Crossing Tower.

power-factor indicator, frequency indicator, voltmeter, ammeter, regulating and recording equipment is installed. A bus-junction panel is provided which enables the steam and hydroelectric services to be paralleled after the usual synchronizing. Each feeder panel is equipped with an ammeter induction wattmeter and overload relay connecting with the 4600-volt oil switches on the floor below. The switchboard is lighted effectively by eleven 16-cp incandescent lamps mounted in a horizontal tin-lined reflector hung by wrought-iron pipe about 10 ft. above the gallery floor. House lighting and small motor service is supplied through three 5-kw transformers distributing energy from a cabinet situated on the switchboard gallery near the operating desk. By means of a double-throw switch the house lighting can be thrown upon either direct or alternating-current service at 110 volts, providing an emergency means of illumination in case of trouble on the alternating-current systems.

The West Boylston textile mills are the largest consumers of the company's service at present, but it is anticipated that a substantial increase in the amount of manufacturing in the vicinity of Easthampton will result from the introduction of the company's power. The Easthampton company distributes energy in the community within radius of the station, and the large textile mills above mentioned will shortly double their capacity.

The accompanying selected cost data have been obtained through the courtesy of the engineers in charge of the design and installation of the high-tension line.

TEST ON GROUNDS IN IOWA SOILS.

The accompanying table gives results reported on the resistance of different types of grounds and ground plates by the committee on "grounded secondaries" of the Iowa Electrical Association at its recent convention at Davenport. The tests at Ames were carried on under the supervision of Professor Fish, of the department of electrical engineering, Iowa State College, while those at Iowa City were under the supervision of Professor Ford, of the department of electrical engineering, Iowa State University. The committee, which has been in existence several years, made a report at the 1910 convention. Part of the grounds reported upon under the tests at Ames were measured last year. The resistance this year of these grounds as compared to a year ago is given in the table

printed below in the column which is headed "Relative to Last Year."

In its report the committee called attention to the fact that the grounds at Ames were constantly moist, while those at Iowa City were on top of a hill where the moisture was less constant. This accounts for the difference in results. The grounds at Ames were in black soil, where water was found 5 ft. below the surface at the driest time of the year. Tests at certain grounds were discontinued because the results were so variable that it was not considered worth while to continue the test. The Garton-Daniels ground in charcoal, which is practically the same as an iron plate, was discontinued because its resistance had increased so much in the first year that it was difficult to measure with the regular instruments used.

The committee noted that there is more variation between maximum and minimum resistance at different seasons in the charcoal grounds than in earth, and also noted that all of the resistances are higher than last year. There was less increase of resistance in the grounds in earth than in charcoal. The grounds using copper plates show higher resistance than grounds of iron plates.

Professor Ford, of Iowa City, in commenting on the tests, said that the results upset all previous ideas about the superiority of grounds in coke and charcoal, and other fancy expensive grounds. The simplest and cheapest grounds of old iron pipe show up better than the more expensive types. He thought the reason for the failure of coke and charcoal to show good results was the fact that they are not pulverized as finely as earth. Therefore they do not retain moisture as well as earth, and it is the moisture-retaining qualitities of the material surrounding a ground that determine its constancy. He gave the following results of a test he had made on the relative resistance measured between two plates buried in different kinds of material in a vessel filled with water up to the level of the top of the material: Gravel, 1800 ohms; water from tap, 400 ohms; sand, 1000 ohms; black loam, 517 ohms; charcoal, 680 ohms. These tests showed the influence of the size of particles on resistance and the fact that the resistance depends on the moisture.

TABLE OF GROUND RESISTANCES.

SUMMARY OF RESULTS AT AMES, IA.

	OHMS.			Relative.	Relative to Last Year.	Ratio of Maximum to Minimum.
	Maximum.	Minimum.	Mean.			
Iron plates in earth	12.0	6.8	9.9	1.18	1.28	1.76
Iron plates in charcoal	16.8	8.3	12.9	1.54	1.55	2.02
Copper plates in earth	10.8	7.1	8.6	1.02	1.13	1.52
Copper plates in charcoal	32.0	9.9	19.6	2.34	2.31	3.24
Aluminum plates in earth	15.1	8.6	11.3	1.34	1.39	1.75
Aluminum plates in charcoal	67.0	15.8	34.8	4.15	3.96	4.25
Garton-Daniels in earth	20.6	8.8	13.0	1.55	1.73	2.34
Garton-Daniels in charcoal			Discontinued			
1.5-in. pipe in 6 ft. earth	15.5	8.8	11.6	1.38	1.45	1.76
1.5-in. pipe in 6 ft. charcoal	38.8	9.4	22.1	2.63	1.72	4.13
1.5-in. pipe in 3 ft. earth			Discontinued			
1.5-in. pipe in 10 ft. earth	11.6	6.2	8.4	1.00	1.27	1.82
1-in. pipe in 15 ft. earth	11.8	7.5	9.8	1.17	1.45	1.57
Paragon cones in earth	34.0	14.2	22.8	2.72	....	2.40
Paragon cones in charcoal	35.6	11.8	19.4	2.31	....	3.02

SUMMARY OF RESULTS AT IOWA CITY, IA.

Federal	540.0	45.8	175.0	8.15	....	11.8
Garton-Daniels in coke	28.9	15.6	21.5	1.00	....	1.85
Universal	119.0	58.0	88.5	4.11	....	2.05
¾-in. pipe in coke	236.0	34.4	118.4	5.5	....	6.85
¾-in. pipe in earth, 5 ft	139.0	28.5	68.2	3.17	....	4.87
Paragon	185.0	43.5	99.5	4.63	....	4.25
1.5-in. pipe in earth, 5 ft	66.0	23.1	40.8	1.9	....	2.86

HYDROELECTRIC STATION AT CLINTON, MASS.

Municipal Plant at the Wachusett Reservoir Dam, Energy from Which Is Sold to the Connecticut River Transmission Company.

BY the closing of a switch at the power plant at the dam of the Wachusett reservoir at Clinton, Mass., by an agent of the Metropolitan Water & Sewerage Board on Aug. 10, 1911, the State of Massachusetts entered on the sale of electrical energy for commercial uses. This is said to be the first instance of a public water supply being used for the development of electric energy to be sold commercially. The event was made possible by a legislative act of 1895, which gave the board authority to utilize the fall of water at any dam under its charge for the production of power or electricity and to transmit such power or electricity by pipes, wires or other suitable means, and sell the same, or the right to use such water, by written or other contracts, for a term not exceeding fifteen years.

In the present case the Water Board has entered into a five-year contract to supply the energy that is generated at the Wachusett dam to the Connecticut River Transmission Company, of Brattleboro, Vt. It is probable that most of the energy will be used by the Lancaster mills at Clinton, to which it has been resold by the transmission company. The energy will be paid for at the rate of 5.3 mills per kw-hour.

The Metropolitan Water Board will draw daily about 100,000,000 gal. from the Wachusett reservoir for the supply of the metropolitan district. This water has a fall of about 90 ft. at the dam. The Legislature of 1908 made an appropriation of $115,000 for the installation of a power plant and last December the board entered into a contract with the S. Morgan Smith Company, of York, Pa., for the construction of the plant, the price being $71,500, and the work was begun in February of this year. The plant is installed in the granite gate house and consists of four turbine units of the spiral-case, horizontal-shaft type, direct-connected to 1000-kva, 60-cycle, three-phase generators. Each turbine takes its supply of water from a vertical pipe having an outlet 4 ft. in diameter. The outlet area of the draft tube measured at right angles to its axis

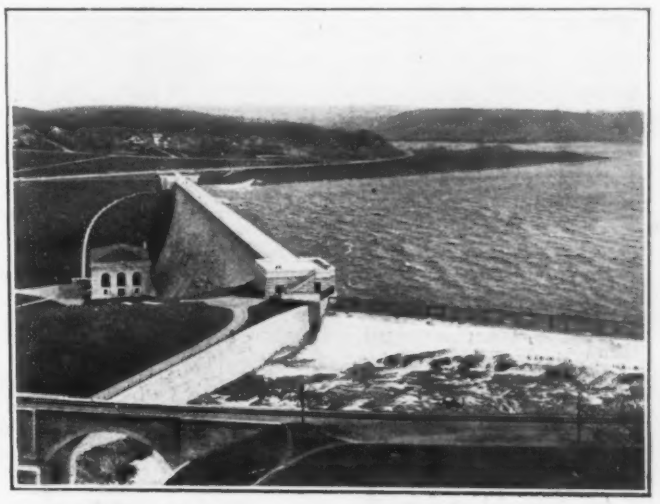


Fig. 1—Dam and Power Plant.

is 38½ sq. ft. The size of each turbine unit is such that when the wicket gates are fully open and the speed is 400 r.p.m. the discharge under a head of 90 ft. is between 160 cu. ft. and 170 cu. ft. per second. The gates are of the wicket pattern, made of steel forgings, with gate and spindle in one piece. The mechanisms for opening and

closing the gates are on the outside of the spiral cases. Each unit is equipped with a governor of the relay type made by the Lombard Governor Company and the governors are fitted with a remote controlling device operating on 60-cycle alternating-current energy from the station switchboard. In addition to the four main Westinghouse generators there are two auxiliary direct-current generators to be used as exciters, connected to two turbines, one

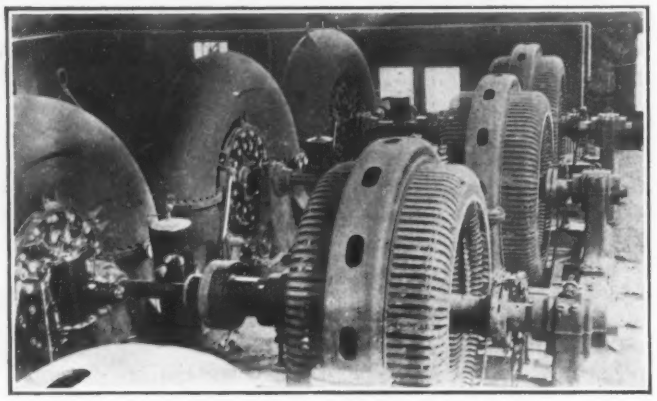


Fig. 2—Interior of Power Plant.

of 90 hp, the other of 110 hp. The completed plant is designed to deliver three-phase, 60-cycle energy at a nominal pressure of 13,800 volts.

The Connecticut River Transmission Company, to which the energy is supplied, has a substation at the Lancaster mills, ½ mile from the dam, and the energy hitherto supplied the mills was brought over its high-tension line from Vermont. There are connected to the lines two frequency chargers, each of about 2000-kw rating. The new plant is designed to operate in parallel with the plants of the Connecticut River Company.

There are three 25-kw air-cooled, oil-insulated transformers in the station so connected that polyphase energy will be available in the station whether the plant of the board is operating or not. The secondary terminals are connected to the three-phase bus on the service panel. The connection with the high-tension bus is made through fuses on the station side of the main meter.

Each of the two transmission lines is provided with electrolytic lightning arresters installed in a concrete lightning-arrester house at the end of the underground cables.

Mr. Dexter Brackett is chief engineer of the Metropolitan Water Works and Mr. E. R. B. Allardice, local works superintendent, to whom the *Electrical World* is indebted for the interior views reproduced, has charge of the plant. Mr. B. C. Thayer is electrician. Prof. W. L. Puffer acted as consulting electrical engineer for the installation.

In order to adjust matters of taxation by the town of Clinton, in which the plant is located, the Legislature of 1909 passed special legislation which fixes the value of the works at $125,000, on which the town may levy its tax.

On the first day of its operation, Aug. 10, only one unit of the plant was operated, but a second unit was put in operation on the following day and before the end of the month the third unit will be used. The fourth unit is to be held in reserve as an auxiliary should repairs be needed.

The Wachusett reservoir contains when full about 65,000,000,000 gal. of water and has a surface of 4195 acres. The main dam is 850 ft. between terminal structures. It is 185 ft. thick at the bottom and 25 ft. thick at the top and has a maximum height above rock foundation of 207 ft. The water is 129 ft. deep. The dam and reservoir cost the State $11,000,000 and required ten years to complete. The basin formerly contained a populous village, mills, schoolhouses and churches.

A STEAM-PLANT TRANSMISSION SYSTEM FOR HARRISON COUNTY, IA., AND WASHINGTON COUNTY, NEB.

By W. A. Trussell.

THE old central station in small towns, operated singly, seems to be losing ground in favor of the transmission system supplying service to a half dozen or more towns. The latter system, moreover, appears to be the only means whereby certain territory with small population may be profitably served.

In 1909 the Bullock Public Service Company bought the old electric-light plant at Missouri Valley, Ia., 3800 population, and also the plant at Blair, Neb., 3500 population, 15 miles distant; later the plant at Logan, Ia., 2000 population, and 9 miles from Missouri Valley, was purchased. Because of the small size of the towns and the adverse conditions under which the older central stations were operated, these plants had never made any money for their owners. They have now been replaced by a modernly equipped central generating plant.

A 625-kva turbo-alternator has just been installed at

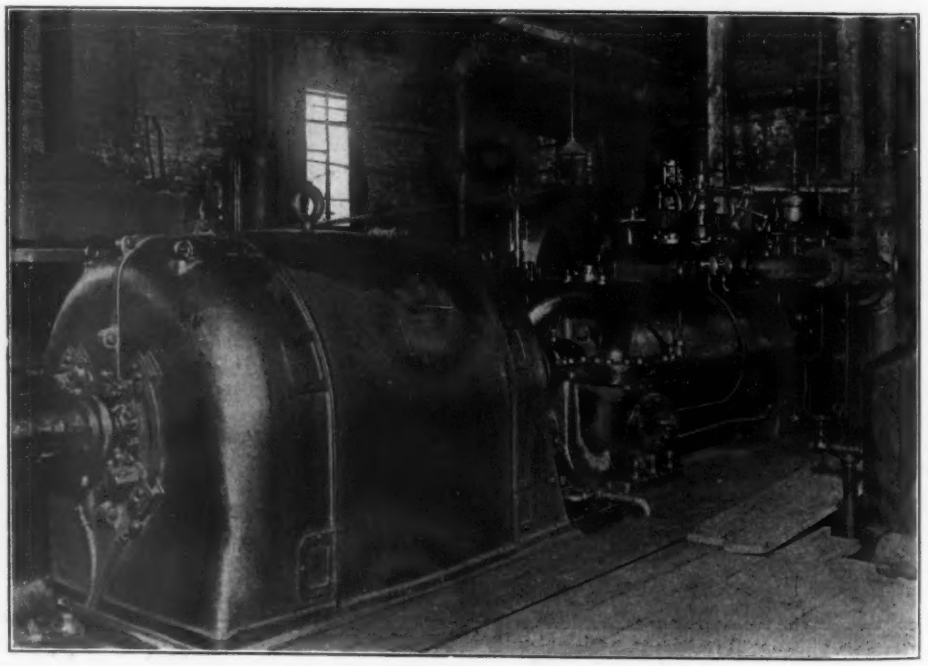


Fig. 1—650-kva Turbine at Missouri Valley, Iowa.

Missouri Valley, and 16,500-volt transmission lines built to Logan and Blair, with a 2-mile branch from the Logan line to Magnolia, Ia., 300 population. A number of enterprising farmers who had been operating a gasoline plant built a 2-mile line to connect with the 2300-volt local distribution in Missouri Valley and are now enjoying reliable twenty-four-hour service. Other towns in the territory will have service as soon as arrangements can be made.

At Missouri Valley 2300-volt, three-phase service is used for the local distribution, and at Blair and Logan 1150 volts. Owing to the small size of Magnolia, voltage is stepped down from 16,500 to 230-115 volts, three-wire, for local distribution. On Sundays the old Blair plant is run and carries the load for the entire system. This keeps

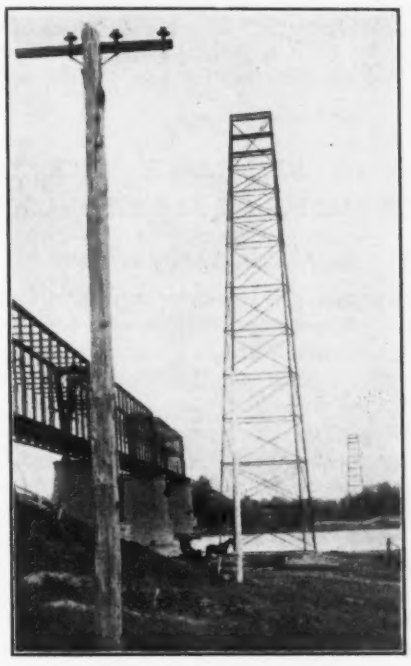


Fig. 2—Span Over Missouri River at Blair, Neb.

the Blair plant in order for emergencies and gives time to clean boilers or make repairs at Missouri Valley.

One of the interesting features of this installation, from an engineering standpoint, is the crossing of the transmission line over the Missouri River near Blair, Neb. As the town is 2½ miles from the river and it is intended to serve other towns near Blair, the main line of 16,500 volts, three-phase, was carried across the river to that town.

Two 100-ft. steel towers were used at the river. They were bought with holes punched and sections numbered, and were built up on the concrete foundations. The towers are 20 ft. square at the base, tapering to a double A at the top, 10 ft. wide. A 10-in. x 12-in. x 10-ft. oak cross-arm is

Fig. 3—Details of Tower and Break Insulator for Main Line of 16,500 Volts.

fastened to the top "saddle." The towers are double-guyed on three sides to concrete anchors with ⅜-in. galvanized messenger cable.

The three cables over the river are spaced 4 ft. apart for the 1200-ft. span and have 30-ft. sag. These cables are seven-strand, ⅜-in. steel, with a heavy copper jacket, and are fastened to double-break insulators at the towers. Guy cables of ½-in. messenger are fastened to the other side of the break insulators, and passing over the cross-arm are anchored in concrete set in the ground 200 ft. back from the towers. This construction leaves very little strain on the towers, except the holding weight of the guys and span cables. A large factor of safety has been provided for all strains.

Extra heavy windmill-type towers were used at all railroad crossings, and 30-ft. white cedar poles were set for country lines.

The turbo-alternator, switchboards, transformers and aluminum cell lightning arresters were made by the Westinghouse Company. The river towers were built and the switchboards and all high-tension apparatus were installed under the direction of Mr. W. A. Trussell, of St. Charles, Mo. Mr. E. A. Bullock, Omaha, Neb., is president and general manager of the Bullock Public Service Company.

A SEMI-GRAPHICAL METHOD FOR DETERMINING THE REGULATION OF TRANSFORMERS AND TRANSMISSION LINES.

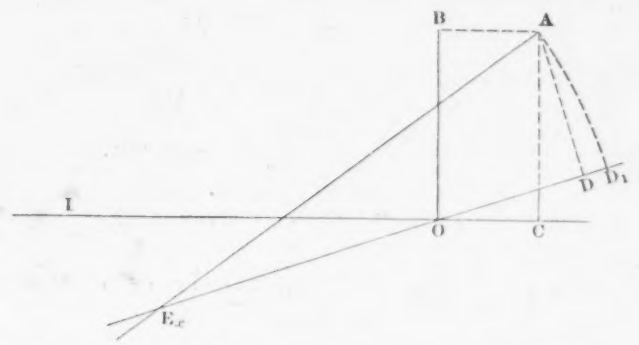
By H. Bewlay.

THE simplest method, theoretically, of calculating the regulation of any inductive circuit is doubtless the one involving the use of the circle diagram. While this method is all that could be desired theoretically, and is satisfactory for some purposes, like all graphical methods it is accurate in practice only when the various quantities involved in the construction are of similar magnitude. This, unfortunately, is a condition seldom if ever found in practical work of the kind under consideration.

To obtain satisfactorily accurate results when considering the regulation of large modern transformers, a diagram having a radius of 50 in. to 100 in. is necessary. The drawing instruments for diagrams of this size require two men to handle them and are, at best, very cumbersome.

The problem as applied to transmission lines has been solved by the use of a table of factors[1] for various frequencies, wire sizes and angles of lag. These factors may be found in the *Electrical World*, Vol. 46, in an article on "Regulation and Efficiency of Transmission Lines," by Dr. Harold Pender.

Having a large number of problems involving inductive circuits, the writer worked out the following method which will be found simple, convenient and sufficiently accurate for all practical purposes. The error in the first result is appreciable only under conditions of very large drop and



Method of Determining Regulation of Transformers and Transmission Lines.

can easily be eliminated by again substituting the value found by the first calculation in the equation and then obtaining a second approximation.

[1] A very complete table giving the physical and electrical constants of wire and the inductance of transmission lines for the various standard spacings will be found in the "Standard Handbook for Electrical Engineers," p. 627.

In the accompanying illustration let
$\overline{OE_x}$ be the delivered voltage;
$\overline{AE_x}$ be the generated voltage;
$\overline{OC}$ be the IR drop;
$\overline{OB}$ be the IX drop, and
$\overline{OA}$ be the IZ drop.

The power-factor of the receiving circuit is the cosine of angle IOE_x, which is the angle of lead of the emf. Draw $\overline{AD}$ perpendicular to $\overline{OE_x}$ and with E_x as a center draw an arc through A intersecting OE_x prolonged at D_1. The triangle E_xOA is the familiar triangle of pressures. As ADE_x is a right angle

$$\overline{AE_x}^2 = \overline{E_xD}^2 + \overline{AD}^2 \qquad (1)$$

$$\overline{AE_x} = \overline{E_xD_1}$$

$$E_xD^2 + \overline{AD}^2 = E_xD_1^2 = E_xD^2 + \overline{DD_1}^2 + 2\,\overline{E_xD} \times \overline{DD_1} \qquad (2)$$

$$\overline{DD_1} = \overline{AD}^2 \div (2\,E_xD + \overline{DD_1}) \qquad (3)$$

As $\overline{DD_1}$ is generally very small compared to $2\,\overline{E_xD}$ it may be dropped from the fraction (3) without great error, and

$$\overline{DD_1} = \overline{AD}^2 \div 2\,E_xD \qquad (3A)$$

If $\overline{DD_1}$, $\overline{AD}$ and $\overline{OD}$ are expressed in per cent of E_xO then

$$DD_1 = \overline{AD}^2 \div (200 + 2\overline{OD}) \qquad (3B)$$

In using this method the drops, $\overline{OC}$ and $\overline{OB}$, are laid off on cross-section paper to a suitable scale and point A is thereby located. Draw an arc having a radius of 100 arbitrary units and with O as a center for a power-factor circle Draw OD for any desired power-factor and erect AD perpendicular to OD. Measure $\overline{AD}$ and $\overline{OD}$ and, by formula (3A) or (3B), calculate $\overline{DD_1}$. This first approximation is usually sufficiently exact, but if the value of $\overline{AD}$ is large or great accuracy is necessary a second value may be obtained by substituting in equation (3) the value of DD_1 found by equation (3A).

The accuracy of the method when the graphical work is done to a convenient scale may be shown by solving Case 1 in the *Electrical World* article mentioned above, using a sheet of 8-in. x 10-in. cross-section paper, a 5-in. compass and a 10-in. slide rule for all calculations.

Data.—Three-phase, three-wire balanced system.
Power delivered, kw, 500.
Voltage delivered (between wires), 10,000.
Power-factor, per cent, 80.
Resistance (one wire), ohms, 18.72.
Reactance (one wire), ohms, 1.078.
Calculations.

Current per wire, amp, $\dfrac{500{,}000}{10{,}000 \times 0.8 \times \sqrt{3}} = 36.1$ amp.

Emf, neutral point to any wire, volts, $\dfrac{10{,}000}{\sqrt{3}} = 5780.$

$$\text{Per cent } IR = \frac{36.1 \times 18.72}{5780} \times 100 = 11.7.$$

$$\text{Per cent } IX = \frac{36.1 \times 1.078}{5780} \times 100 = 0.673.$$

Per cent $AD = 6.5$; $OD = 9.77$; DD_1 by (3B) $= 0.192$;
$OD_1 = OD + DD_1 = 9.96.$

The correct regulation as given in the article is 9.92 per cent, and hence the error in the drop is 0.4 per cent. This error is well within the limits of error of the slide rule and the graphical work and the allowable error in practical calculations of this nature.

The error due to dropping DD_1 from equation (3) is very small for diagrams of the usual proportions. The following table gives the amount of this error in terms of E_xD for various values of AD.

AD/ExD.	Error Equation (3A).	Error Second Approximation.
0.1	+ 0.000013	
0.2	+ 0.0002	— 0.000002
0.4	+ 0.003	— 0.0001
0 8	+ 0.04	— 0.0042

From the above table it will be seen that a second approximation is necessary only when $AD > \dfrac{E_xD}{4}$; in extreme cases where $AD > \dfrac{E_xD}{2}$ a third approximation may sometimes be desirable.

VARIATION OF RESISTANCE WITH TEMPERATURE SHOWN BY NERNST GLOWER.

By Albert A. Somerville.

THE Nernst lamp is the development of Prof. Walther Nernst, of Göttingen University, who produced the glower which bears his name while investigating certain substances, such as thorium, cerium, zirconium, erbium, tythrium and glucinum, used in the Welsbach mantle. Among these Dr. Nernst experimented with magnesium oxide mixed with porcelain, which, while an insulator when cold, he found to be a good electrolytic conductor when hot. The present Nernst glowers or filaments are made from kaolin.

Owing to the high resistance of the glower when cold, the lamp is started by heating the glower with a match or by means of an automatic electric heater. This electric heater is cut out of circuit by an electromagnet as soon as the glower begins to conduct. The glower resistance decreases rapidly as its temperature increases, so a ballast or balancing resistance having a large positive temperature coefficient of resistance must be used in series with it. This ballast usually consists of an iron wire, sealed in glass to prevent its oxidation and surrounded by hydrogen to conduct heat away more rapidly.

Since the glower in operation is intrinsically very bright it must usually be inclosed in a ground-glass shade when used as a light source for interior illumination. This high intensity also permits its use as a point source of light to be reflected from the moving mirror of a galvanometer, giving an excellent mark on a scale or screen.

On account of the electrolytic nature of the conduction occurring in the glowers they are used generally on alternating-current lines and last longer under this condition than when on a direct-current line. The platinum heater is also gradually destroyed due to vaporization of the platinum below its melting point, but the iron ballast may last for years. The watts consumption per candle-power varies with the number of filaments in parallel, due to the mutual heating effect of one filament upon the other, the radiation varying as the fourth power of the absolute temperature.

The usual form in which these filaments are put on the market is that of comparatively short, thick rods which are connected in multiple to make up the required candle-power of the unit. Each rod or filament is about 13 mm in length and 1 mm in diameter. In the present series of tests, however, most of the measurements were made by using two single-glower filaments connected in series, the resistance of the pair being, of course, four times that of the same units connected in parallel. The resistance was measured by means of a dial bridge, no dummy leads being used since the resistance of the lead wires could easily be neglected in comparison with that of the filament itself. The greatest source of possible error was due to thermal emfs, for the thermal emf set up between a Nernst filament and a platinum wire connected to it is larger than that for any other two elements or alloys known to the writer. By connecting in series the glowers lying parallel with each

other, however, their terminals could be brought to within almost 1 mm distance and thus to almost exactly the same temperature, unless the temperature gradient was quite large, which could be prevented by inclosing the glowers in a suitable furnace. Thermal emfs were thus neutralized or reduced practically to zero, for the arrangement used gave four junctions, with the emfs set up in adjacent joints neutralizing each other in case the two ends, about 13 mm apart, were not quite at the same temperature. The glowers could be insulated either by suspending the whole specimen in the air or by placing a strip of mica between the lead wires, mica being the only substance known to the

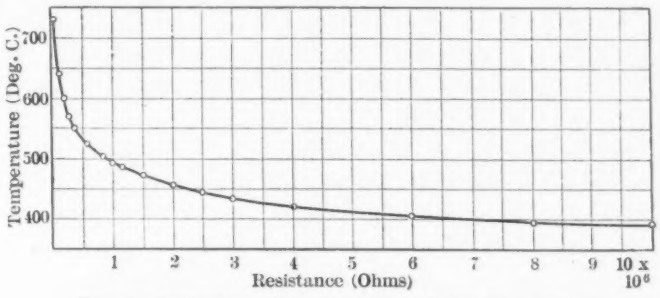


Fig. 1—Resistance Between 400 and 700 Deg. Cent.

writer that does not become a conductor at temperatures of 1000 deg. C. or higher.

The heating was done in a 110-volt direct-current electrical resistance furnace which could be readily controlled by means of a rheostat. The furnace, which takes a maximum current of 12 amp at 110 volts, is similar to one already described in the *Physical Review*, September, 1910, and in the *Electrical World*, Nov. 17, 1910.

As there was no difficulty due to oxidation or danger of the specimen melting at the temperature attainable in such a furnace, the principal points to be observed after mounting the specimen, in good condition, horizontally in the tubular furnace were to measure its resistance frequently, meanwhile gradually increasing the temperature of the furnace and measuring this temperature at the same time that resistance readings were being taken. Usually the temperature could be run up to a maximum in about three hours' time.

A platinum resistance thermometer was used to determine temperatures up to about 1000 deg. C., while a platinum platinum-rhodium thermo-junction was employed beyond the range of the platinum thermometer. The resistance thermometer was connected to a Callendar automatic

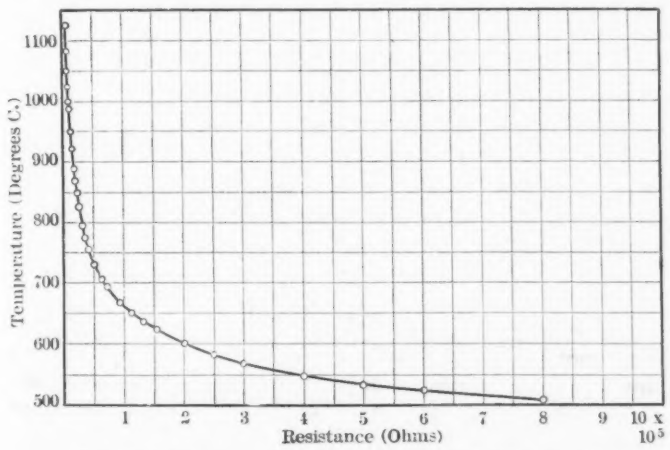


Fig. 2—Resistance Between 500 and 1100 Deg. Cent.

temperature recorder and so gave a temperature-time record of the first part of the run. As it was not advisable to use the resistance thermometer much above 1000 deg. C., the latter was taken from the furnace when this temperature was reached, and the run continued without interruption. Temperatures above this were read by means of a potentiometer and the thermocouple, one junction of which had been in the furnace during the entire time the furnace had been heating. An excellent calibration was obtained on the resistance thermometer and a fairly good

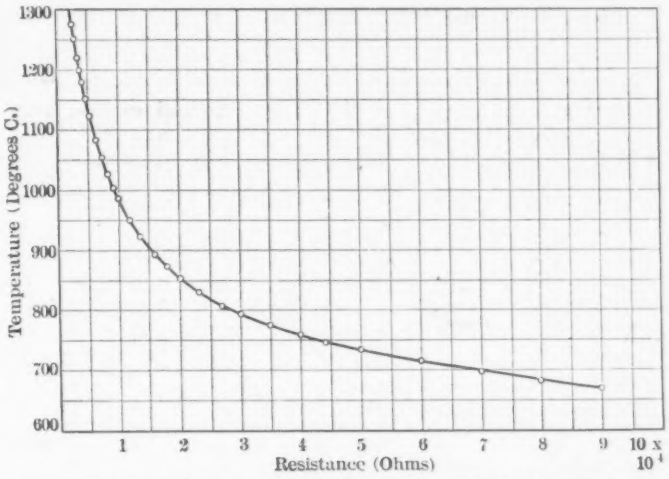


Fig. 3—Resistance Between 700 and 1300 Deg. Cent.

one was secured for the thermocouple. The actual temperatures were then computed, and the resistance of the Nernst filament was plotted against temperature, as shown in the accompanying curves.

The upper limit of the Wheatstone bridge was 10,000,000 ohms, so that this value was the first resistance measured, as shown in Fig. 1, the temperature being about 390 deg. C., as nearly as could be determined. The resistance then drops very rapidly with increase in temperature, decreasing about 9,000,000 ohms in 100 deg. rise in temperature. Using a scale, which is necessary to show the first part of the curve to advantage, that part of the curve above 700 deg. is of little or no value, as it appears to be simply parallel to the *X* or temperature axis.

In Fig. 2 a second curve has been prepared, plotting resistance on a scale ten times as large as in Fig. 1, and discarding the upper part of the curve above 1,000,000 ohms. In Fig. 3 the scale of the resistance axis is again expanded to ten times that in Fig. 2, and, finally, in Fig. 4 the same axis is once more magnified until it reaches a scale 1000 times as great as in Fig. 1, the scales of the temperature axes meanwhile remaining the same for all the curves. The smoothness of the curves indicates the accuracy with which the work can be done.

The resistance of two filaments in parallel on a 110-volt circuit is about 100 ohms measured by the fall-of-potential method. The resistance of the same two filaments con-

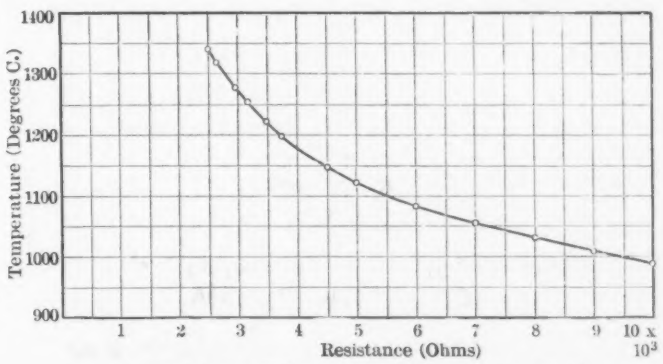


Fig. 4—Resistance Between 1000 and 1350 Deg. Cent.

nected in series would be about 400 ohms, but without knowledge of the temperature at which they operate the curve beyond that shown in Fig. 4 can only be conjectured.

The experimental work herein reported was performed at the physical laboratory of Cornell University.

THREE-WIRE BALANCERS.

By George T. Hanchett.

The direct-current balancer commonly consists of either a dynamotor comprising one armature with two similar windings and two commutators or a motor-generator consisting of two similar machines coupled together. The permissible output of such a machine is theoretically the rating of one winding, but practically the armature drops and brush contacts become determining elements before such an output is reached. The brush-contact effect is often serious; the writer has noted cases where improvement in brush contact has restored a lack of voltage balance of 2 per cent or 3 per cent.

The three-wire machine offers some advantages over the types commonly used for direct-current balancer. This machine consists of a rotary converter, single-phase or polyphase, the collector rings of which are connected to the terminals of an auto-transformer balance coil, the neutral being taken from the common center. Such a machine is shown in Fig. 1. The mechanical advantages of the three-wire balancer over the two-machine balancer may be listed as follows: One commutator versus two, reduction of brush-contact trouble, two bearings versus three or four, compact structure, absence of torque in shaft or couplings. These advantages are to be considered seriously for the reason that the duty of the balancer is often a long-term duty, for it is frequently installed without reserve and must run continuously.

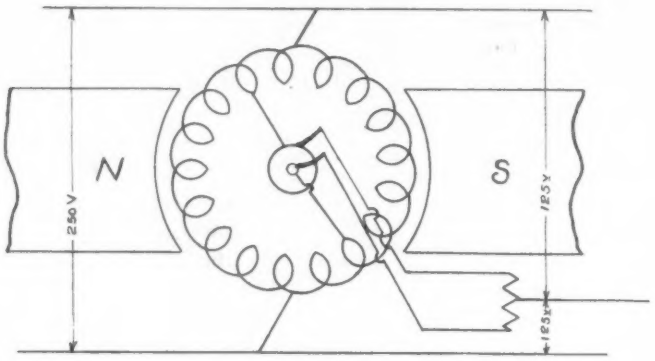


Fig. 1—Three-Wire Balancer.

The writer has found that in spite of the elemental simplicity of this machine and its prototype, the three-wire generator, there is much misconception as to the action of the auto-transformer balance coil as well as pronounced confusion in considering emfs and currents existing in the system.

Referring to Fig. 2, it is most convenient to study first the current distribution within the system and second the voltages that obtain. In each case the collector rings have been omitted to facilitate simplicity.

It is well to consider first the machine as one of perfect efficiency requiring no power to supply its losses and then to superpose the driving currents and the balance-coil currents in a manner which will be shown in the following.

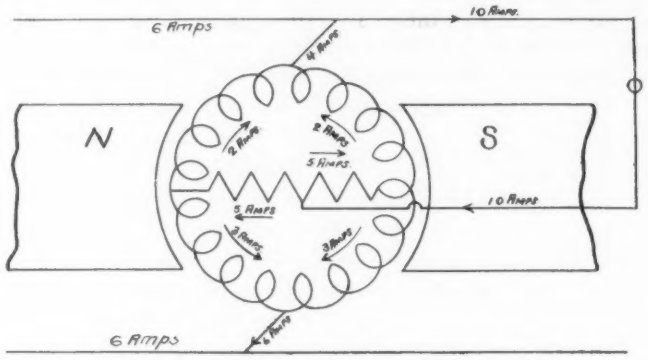


Fig. 3—Current Distribution in Balancer.

In the position indicated in Fig. 2 the balance coil is connected between equal potential points on the armature winding. In other words, the alternating emf is in this instance zero and the direct current from the neutral passes through the balance coil, which acts merely as a wire connector. It will be observed that the current splits at the common center and again at the tap to the armature winding, half going upward to the positive brush and half downward to the negative. The upper half of the armature acts as a generator supplying the extra 5 amp; the lower half is a motor supplying the torque necessary to compensate for the back drag on the upper half. The torques are balanced, there being as many current-carrying wires in one direction under the north pole as there are in the opposite, and it is curious to note that both positive and negative brushes of the machine are supplying current outward from the winding, one to the load and the other back to the mains.

As the balancer requires current to drive it, say 1 amp, the current distribution is as shown in Fig. 3, the generator half of the armature carrying less current than the motor half and the negative brush supplying less current than the positive. The torques are now unbalanced in favor of the motor side, which causes the machine to revolve. In

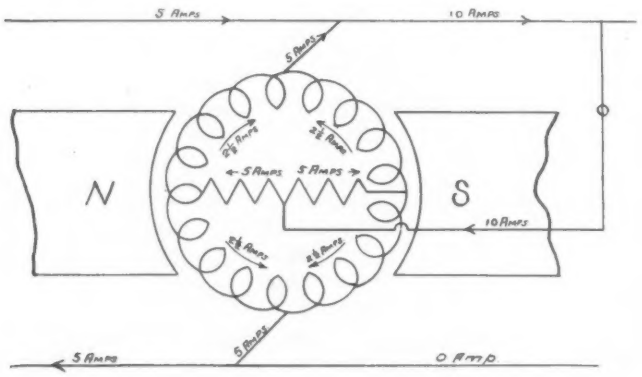


Fig. 2—Current Distribution in Balancer.

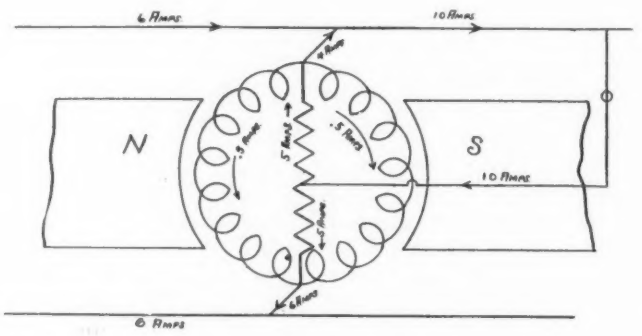


Fig. 4—Current Distribution in Balancer.

the condition shown in Fig. 4 the duty of supplying the neutral-wire unbalanced current is deputed solely to the balance coil, which now, being between points of opposite potential, is on the crest of its emf wave and acts as a transformer carrying 5 amp locally in the upper half and 5 amp locally through the lower half. The magnet-carrying current is supplied from the armature

winding and should in this case be represented by an increased lower current and reduced upper current, but has been omitted for the sake of simplicity. In this position the armature winding carries only the current necessary to drive the armature, the torque current, it will be observed, being half the current carried in the case of Fig. 3 distributed through all the windings.

In intermediate positions, as for instance the 45-deg. position, the same current relations still remain. The effective torque remains the same, although it is now accomplished by surplus of "motor conductors" in front of the south pole to compensate the reduced "motor conductors" in front of the north. The emfs which produce these currents are due to a combination of the emfs in the balance coils and in the armature, and it will be observed by those who care to go into the mathematics of the case that the sum of the instantaneous emf in the balance coil and the integral of the emfs of the armature between the brush and the transformer tap to the winding is equal to one-half the commutator voltage, and, furthermore, this relation is true whatever electric angularity the balance coil with reference to the taps may have with the brushes.

There exists, therefore, the curious condition of a constant direct current in the balance coils, although the latter is subjected to alternating emf, this direct current being alternately propelled by a portion of the armature voltage and by the transformer action on the balance coil itself, the one supplanting the other in perfect symmetrical gradations.

It will also be observed that while the current in the balance coil is a constant load the current in the armature windings is variable, according to whether the portion under consideration is acting as a generator or motor. It is plain that in practice the brushes of such a machine will have to be set at the theoretical commutation zone, for one is commutating as a motor and the other as a generator. Fortunately for the commutation, the armature reactions of the balance currents neutralize one another and the one disturbing reaction is that due to the torque current, which is practically constant no matter what the load on the balancer may be and is always small, being merely enough to spin the armature in its bearings at the required speed.

A further feature of interest about this machine is the fact that the neutral cannot be shifted by changing the connection on the auto-transformer balancer. Considering the extreme case of the neutral tap being transferred to the end of the balance coil and tapped to the armature windings, the voltage would obviously rise from zero to double the normal half voltage in a succession of pulsating crests. If the frequency were high enough and the thermal inertia of lamp filaments great enough, practically no change in their brilliancy would be noticed. As the neutral tap is moved down the balance coil toward the center the surges of direct voltage begin to disappear and at center the emf is smooth and constant, but in no other position is the average value materially disturbed.

The neutral voltage can be shifted to either one side or the other only by virtue of the *IR* "drops" in the winding. These could be corrected very largely by splitting the pole pieces on the median line and winding the split halves with turns carrying current from the neutral winding, the effect of which would be to strengthen the generator half of the balancer and weaken the motor half. The operation would be automatically reversed if load were thrown to the other side of the three-wire system, thereby requiring a reversal of functions of the two halves of the armature. This device has never been employed, so far as the writer is aware.

Central Station
Management, Policies and Commercial Methods

INSTALLATION OF MOTORS IN DENVER.

The Denver Gas & Electric Light Company has made standard the use of 2200-volt motors for all sizes above 50 hp. All such installations are made with lead-covered cable in conduit and protected at service entrance with an overload no-voltage-release, oil-immersed circuit-breaker, covering the requirements of the National Electrical Code and Denver electrical ordinance.

MAKING BUTTER TO ORDER BY ELECTRICITY.

One of the customers of the New York Edison Company has a very up-to-date grocery store and has recently added to his list of electrically driven appliances a 1½-hp motor for driving a churn. His patrons purchase cream at the store and for a small charge have it made into butter on the spot. The method is not only an excellent advertisement for the grocer, but is also instructive for the children and others in the neighborhood.

THE FIELD FOR THE ELECTRIC COMMERCIAL VEHICLE.

It is estimated that at least sixteen times as much freight is handled by wagons as by rail, and that 3,000,000 power vehicles would be required in the United States to handle the freight and packages that can advantageously be transported by electric vehicle. In Boston alone about 25,000 tons of freight are hauled daily through the streets for distribution. The above figures indicate the great future of the commercial electric vehicle, and should be of particular interest to central-station men owing to the prospect opened for the sale of electric power for charging batteries under ideal load-curve conditions.

HIGH-TENSION DISCONNECTING SWITCHES IN CENTRAL STATIONS.

A central-station practice rapidly growing is to place disconnecting switches in series with the busbar side of high-tension oil circuit-breakers or switches so that when it becomes necessary to adjust or inspect the breaker mechanisms this can be accomplished without danger to the operator. Another useful feature is that should the oil breaker prove defective or develop short-circuits within itself the trouble can be localized by opening the disconnecting switches.

In station lightning-arrester installations the use of disconnecting switches is necessary if it is desired to maintain the arresters in operative condition. By locating the switch between the line and arrester section a circuit can be opened and the units, being entirely disconnected, can be safely cleaned, inspected and adjusted. Sectionalizing of high-tension busbars is also most economically effected by location of disconnecting switches in the busbar compartments.

Where the busbars are carried through trenches of concrete or brickwork the switches can be secured to the floor or side walls, as desired.

In a recent installation made by the Delta-Star Electric Company, of Chicago, Ill., illustrated herewith, the switches are mounted directly in the busbars of the heavier capacity circuits and on pipe framework for the smaller capacities. A flexibility of operation is thus secured which is very desirable and tends to increase the continuity of service by permitting instant localization of trouble. Proper use of such sectionalizing devices also insures a uniform workmanlike construction, the importance of which is obvious.

HOTEL PFISTER, MILWAUKEE, CHANGES TO CENTRAL-STATION SERVICE.

The Hotel Pfister, of Milwaukee, which has been the scene of many electrical conventions, has discarded its isolated plant and now obtains all its electrical energy from the Milwaukee Electric Railway & Light Company and the Milwaukee Central Heating Company. The hotel is located at the corner of Wisconsin and Jefferson Streets

A Bright Spot
The Hotel Pfister to Have Central Station Service
The same close attention on the part of the management to every detail that will add to the efficient service, which has made the name of The Hotel Pfister stand for so much to the traveling public, has decided them to do away with their present system of a private steam and electrical plant and to use instead Central Station Service.
Central Station High Pressure Steam Service for cooking and laundry purposes.
Central Station Low Pressure Steam Service for heating service.
Central Station Electric Service for light and power, approximately 300 horse-power capacity.
Central Station Service is modern, convenient and economical for the home, apartment building, store or factory. Let our engineers make a free test of your plant. Valuable information may result
The Milwaukee Electric Railway & Light Co.
"THE ELECTRIC COMPANY"
CENTRAL STATION

Advertisement of Hotel Pfister Service.

and consists of nine stories, each 180 ft. x 117 ft. in floor dimensions. The building, with the servants' quarters and garage, contains 2,125,000 cu. ft. The elevator equipment consists of two passenger elevators, two freight elevators and one dumb-waiter rising the entire height of the building. These elevators are of the hydraulic type, operated by steam pumps.

The old steam plant consisted of four return tubular boilers rated at 100 hp each and equipped with Hawley down-draft furnaces. The boilers were built for 100-lb. working pressure, but this was reduced recently by order of a boiler insurance company. The old plant also included three 110-volt Thomson-Houston dynamos rated respectively at 40 kw, 50 kw and 90 kw, belted to a jackshaft, in turn belted to two Allis-Corliss simple non-condensing engines.

Steam heating is maintained by direct radiation supplied by a single-line gravity system of piping. Low-pressure steam is used for heating the hot water used throughout the building and high-pressure steam is utilized in various parts of the hotel as follows: Kitchens, 40 lb. pressure; Turkish bath, 25 lb. to 30 lb. pressure; laundry, café and bakery, 80 lb. pressure. This steam was taken directly from the boilers.

In replacing a private plant with central-station service, and especially where hydraulic elevators are installed, two serious problems arise. The first of these is the extensive use of steam for many purposes, and the second the operation of the elevators. In Milwaukee the central-station company also supplies steam in the business district through an allied company, and so the question of steam supply in this instance was met by connecting the customer's installation to the company's steam mains in the street.

In the matter of the elevators, after carefully considering the advisability of replacing the hydraulic elevators with new elevators of the electric traction type, the commercial engineering department of the Milwaukee Electric Railway & Light Company recommended the installation of electrically driven three-stage turbine pumps, feeling that even if in five years the present elevators were replaced by electric elevators the expenditure for the electric pumps would be warranted, even though the traction type elevators could be operated somewhat more economically. The elevator service will be maintained by three 4-in. three-stage turbine pumps operated by 50-hp motors turning at 1500 r.p.m. and equipped with Cutler-Hammer pressure regulators and self-starters. These motors are of a late inner-pole type, built by the General Electric Company under specifications of the National Board of Fire Underwriters. The pumps were installed by the Alberger Pump Company.

Of course, the existing lamp and motor circuits in the hotel were supplied directly from the central-station company's mains. In summing up the recommendations to the management of the hotel the commercial engineering department of the central-station company urged the installation of a refrigerating plant operated by an electric motor whereby a saving of 50 per cent could be effected over the cost of ice purchased from local dealers.

Herewith is given a reproduction of an advertisement referring to the change of utility service in this well-known hotel, the central-station company having taken advantage of this important accession to direct attention to the fact.

ELECTRICAL PUMPING FOR MUNICIPALITIES AND FOR IRRIGATION.

Among the largest potential customers for electrical energy in this country are our cities, said Mr. B. H. Gardner, power engineer for the Dayton (Ohio) Lighting Company, in a paper on electric pumping read before the recent Ohio Electric Light Association convention at Cedar Point. Practically every city owns and operates its own water system, and in the operation of these systems large amounts of power are used. Up to the present time very little has been accomplished by central-station companies in securing this business. Each year, however, sees a greater amount of this pumping being done with electric power, and the indications are that this business will grow very rapidly during the next few years.

Of course the chief field for the possible use of electric power is in the main city pumping stations for the supply of water for drinking as well as other domestic purposes.

This load offers a great many attractive features from the central-station man's point of view.

In a general way there are two kinds of water-works systems in use in this country, one a direct system where no reservoir capacity is provided, the rate of pumping water varying directly as the demand for water, and the reservoir system, where a reservoir is provided so that water may be supplied after the pumps are shut down. Of the two systems the most attractive and the easiest to get on a profitable basis is, of course, the reservoir system. With such a system the pumping can be very largely done at such times as best suits the load conditions of the central station and so can be made practically "off-peak" business. For such business the central station can offer very low rates and still make a profit.

In a direct system of course the reservoir feature is lacking, and for this reason this pumping business does not offer so great an attraction for the central station. It must be remembered, however, that the greatest demands for water are during the months from April to October, when the demand for electric energy is least; and the demands for water are least from October to April, when the demand for energy is greatest. There is thus an annual diversity factor offered, even in direct systems, which is most attractive. Practically all new systems being installed have the reservoir feature, so that there is an opportunity for the central stations of the country to secure most of this business as "off-peak" business. For the direct systems that are already installed, probably the best method of securing this business is by advocating a combined station, the old steam equipment to operate during peak months, etc., and motor-driven pumps to carry the summer peaks. This arrangement gives the central station a diversity factor that should be most acceptable.

In many cities the suburbs are built upon hills that are often considerably above the city proper. In many cases the water pressure which is suitable for the main portion of the city is entirely too low for the suburbs, so that the pressure of the water furnished the suburb has to be boosted. Sometimes special high-pressure mains are provided for such suburbs, but a simpler way is by installing local motor-driven boosting stations in the suburb. This is business that the central station should have little difficulty in securing.

Mr. Gardner quoted from the *Electrical World* an account of the extent of irrigation pumping in Colorado and remarked that many persons have formed the erroneous idea that while irrigation is a good thing for the Far West, where there is little rainfall, it is not practicable in the East. But Eastern farmers will soon use irrigation for the same reason that they now use fertilizers, because the increased production of the land will much more than pay the cost.

Dr. Bailey, of Cornell University, a prominent agriculturist, said in a recent speech: "Now and then a forehanded farmer in the humid region, growing high-class crops, installs an irrigation plant to carry him through the dry spells. As our agriculture becomes more developed we shall greatly extend this practice. We shall find that even in humid countries we cannot afford to lose the rainfall from hills in floods, and we shall hold at least some of it against the time of drought, as well as for cities and for power. We have not yet learned how to irrigate in humid regions, for the practice of draining is equally involved, but we certainly shall apply water as well as manures to supplement the usual agricultural practices."

The president of the Western New York Horticultural Society in a recent address before 1500 fruit growers also said: "Last summer's drought, lasting three months, injured a great many crops, especially the apple crop, the fruit not being, on an average, over half size; all due, in my opinion, to the dry season in July, August and September. If we had had an abundant supply of water to turn upon the orchards the crops would have been saved."

When irrigation does come into its own the central-station load should be greatly increased. The ease and economy with which electricity can be transmitted over wide areas and used to drive motors make electric pumping preferable to the gravity system of irrigation in many ways. The pumps can be in comparatively small units, each supplying a local area. The distributing ditches are small, thus leaving maximum area for crops, and the water supply to each area is always under perfect control. There is minimum danger of broken ditches and flooded crops such as sometimes occur with large ditches.

The maximum practical cost of such pumping depends on the value of the crop and the cost of transportation to market. The height to which water can be pumped economically also depends on the same factors.

The quantity of water needed for irrigation varies with the location of the land, the nature of the soil, the kind of crop, the state of growth of the crop, etc. Some crops require more moisture than others and all require their greatest quantity of moisture during the season of most vigorous growth. An average of eight acre-inches per month during the irrigation season is considered ample in most cases. The irrigation season usually lasts about three months for each crop.

Tests made by the United States government indicate that where the water does not have to be lifted more than 25 ft. and where the cost of energy is 3 cents per kw-hour the cost of irrigation will not be more than $3 per acre-foot, or an annual cost of $6 for two acre-feet, the quantity usually needed per year.

When we take into consideration the enormous loss that the farmers each year suffer on account of droughts this seems a rather cheap way of overcoming this loss. To those companies which are so situated that water may be easily obtained it seems that irrigation offers an excellent opportunity to improve the central stations' load factor and raise their income.

Discussion.

An instance where a small town planning to install motor-driven pumps for its water works was threatened with an increase of 35 per cent on the rates of all insured property in the town unless steam was maintained was cited by Mr. Kaylor, of Norwalk, Ohio. The community had planned to purchase transmitted energy from a neighboring town, but the insurance companies declared any kind of electrical pumping to be a serious hazard. Refuting this charge, Mr. Gardner told of the use of motor-driven water works in many cities, including Duluth, and mentioned New York's electrically driven high-pressure fire-protection system. Mr. W. S. Culver, of Schenectady, N. Y., pointed out that the pressure of a standpipe would doubtless lower such a rate. The chief danger of discontinuity in electric service, he said, lies in the transmission line, which is most likely to give trouble during high winds, when serious fires are likely to occur. Mr. D. L. Gaskill, of Greenville, Ohio, advised against any central station's taking over the operation of a water-works system not equipped with a standpipe. Mr. J. C. Martin, of Wilmington, Ohio, observed that a profitable use for electric pumping lies in small individual outfits for pumping cistern and well water to houses, etc.

STEAM VS. CENTRAL-STATION ENERGY IN A MATTRESS FACTORY.

By F. B. Fletcher.

In getting the business of the Oates Mattress Company, which was the only mattress factory in the city of Little Rock, Ark., not upon the lines of the Little Rock Railway & Electric Company, that company submitted the following report of a test run upon the plant under actual operating conditions.

In this plant steam was supplied from the boilers to a 225-hp Corliss engine driving the furniture factory, to a 125-hp engine driving the mattress factory and to the dry kilns, hot rooms and heating system. Since steam was

REPORT OF TEST.

Boilers and Engines:

Two 125 rated horse-power fire-tube boilers, natural draft.
One 125 rated horse-power simple Corliss non-condensing engine, 14" x 36"; average clearance 5 per cent; connected to shafting by belt; diameter piston rod, 3".
Boiler feed pump, simplex, 7" x 5" x 12".

Total and Average Quantities:

Method, alternate	
Duration of test	9 hours
Total quantity of coal fed to boilers	7,200 lb.
Total quantity of shavings fed to boilers	2,770 lb.
Total quantity of fuel	9,970 lb.
Per cent coal per pound of fuel	72.3 lb.
Total quantity water fed to boilers	60,250 lb.
Maximum horse-power required, all machines full load	57.7
Minimum horse-power required, shafting alone	24.6
Friction loss in shafting, horse-power	23.1
Average horse-power required to drive	40.5
Average horse-power required to drive less friction (40.5—24.6)	15.9
Average steam consumption of engine in pounds of steam per hp-hour	48.44
Average evaporation of boiler in pounds of water per pound of coal	6
Average pounds coal used per day equal $\frac{48.44 \times 40.5 \times 10 \times 72.3\%}{6}$	

necessary for the operation of the main factory the item of labor saving in the boiler and engine-room could not be taken into the operating costs, but in spite of this electricity effects a considerable saving. Water is free, the

TOTAL MONTHLY COST OF STEAM PLANT.

Initial cost of engine and piping		$2000.00
Fixed charges—		
Depreciation—5 per cent on $2,000	$100.00	
Interest —6 per cent on 2,000	120.00	
Taxes and insurance—3 per cent on $2,000	60.00	
Total fixed charges		$280.00
Fixed charges per month		$23.33

OPERATING EXPENSES.

Coal at $2 per ton (average)	$61.50	
Repairs	6.25	
Engine and cylinder oil	6.00	
Belts	5.00	
Shafting oil	5.00	
Waste	.50	
Total	$84.25	
Total monthly expense		$107.58

plant being situated on the river bank. The capacity of the factory is 125 mattresses per day.

Since the average actual consumption of power at the machines is 40.5 — 24.6 equals 15.9 hp, and since all frictional losses would be excluded by an individual motor drive, the number of hp-hours used per month would be $16 \times 10 \times 26$, or 4160 hp-hours, or 3120 kw-hours per month.

The maximum possible demand is 57.7 — 24.6, or 23.1 hp. It is proposed to install a Wright demand meter, and, assuming a maximum demand as registered by this meter of 25 hp and a monthly consumption of 3120 kw-hours, the monthly charge for energy would be $95.22, according to the company's power rate. This is equivalent to electrical energy at 3 cents per kw-hour.

In addition to the saving thus effected the importance cannot be emphasized too strongly of using central-station

TABLE A.—UNIT COSTS OF POWER REQUIRED TO PRODUCE ONE COMMON MATTRESS—WEIGHT, 45 LB.

Operation of Manufacture.	Weight of Material, Pounds.	Time Required, Hours.	Hp-Hours.	Cost in Cents.		Saving by Use of Electricity.
				Steam.	Electricity.	
Cutting coarse excelsior	37	.0925	.666	1.750	1.50	.250
Cutting fine excelsior	5	.025	.072	.190	.160	.030
Felting cotton	3	.0187	.027	.070	.060	.010
Wooling cotton	3	.0094	.0081	.02	.018	.003
Making ticks	..	.0333	.0143	.037	.032	.005
Stuffing ticks	..	.0084	.0047	.012	.011	.001
Sewing end of mattress	..	.0166	.00078	.002	.0017	.0003
Elevating mattress to second floor	..	.0082	.00236	.006	.005	.001
Total	..	*.2121	.79624	2.087	1.7877	.3003

*This does not represent the actual time, as these operations are simultaneous.

energy, since it insures absolute certainty and complete independence of operation. The mattress factory frequently operates thirteen hours per day, thereby entailing the necessity of keeping the boilers fired up and retaining the engineer and fireman over time. The cost of a breakdown at the engine or shafting is an intangible matter in a report of this character, but it is a very real item in the daily and economic operation of the plant.

Two tables accompany the report, one of which (A) gives the result of an economic time study of the power requirements of making one common mattress, includ-

TABLE B.—SIZES AND TYPES OF THREE-PHASE, 60-CYCLE, 220-VOLT MOTORS.

Machine.	Make.	Capacity per Hour.	Horse-power, Motors.	Form	Net Price F.O.B. Chicago.	Shipping Weight, Pounds.	Revolutions per Minute, Motor.	Size Motor Pulley in Inches.		Revolutions per Minute, Machine.	Pulley on Machine in Inches.	
								Actual.	Necessary.		Actual.	Necessary.
1	2	3	4	5	6	7	8	9	10	11	12	13
Horizontal coarse-cut excelsior	L. T. Kline Co	400 lb.	25	..	....	1470	1200	10	6	209	35	57½
Vertical fine-cut excelsior	Fischer-Davis	200 lb.	5	..	....	840	1200	5	3½	175	24	34⅜
Two felting machines (each)	Phila. Textile Co.	160 lb.	5	..	....	840	1200	5	3⅜	202	20	29¾
Excelsior baler	Indianap. El. Mfg. Co.	8 bales	5	..	....	420	1200	5	3½	172	22	34⅜
Exhaust fan	Garden City	....	3	..	....	190	1800	4½	5	1000	6	8
Wooler	Phila. Textile Co.	300 lb.	5	..	....	420	1200	5	5¼	390	16	21
Mattress hoist	....	60	1	..	....	100	1800	3½	⅝	40	24	157
Four sewing machines	Union	12 ticks each	1½	..	....	150	1200	4½	1⅞	270	8	20
One sewing machine	....	12 ticks each	⅛	..	....	50	1800	2½	....	270	8	16½
Cut-off saw	....	....	3	..	....	190	1800	4½	....	1000	....	8
Emery wheel	....	....	1	..	....	100	1800	3½	....	1000	....	6⅜
*Stuffer	....	12 ticks each	2	..	....	150	1800	4½	....	....	....	....
			56⅔	..	$1,150.00	4920						

*Note: Steam stuffer must be replaced by special electrically driven one.

ing the unit costs of steam and electricity for each operation. Table B contains an estimate of the physical cost of installing a motor drive, together with recommendations as to the capacity, type and speed. Column 10 gives the necessary size of the pulleys on the motors, if the pulleys on the machines are not to be changed; column 13 gives the necessary sizes of the machine pulleys in case the motors are purchased with the standard-size pulleys as shown in column 9.

From Table B the following table of initial cost is derived:

Motors	$1,150.00
Freight	52.00
Wiring	250.00
Contingencies	48.00
Total	$1,500.00
Less credit on engine, minimum	750.00
Revised total	$750.00

At a net saving of $144 per year for power this produces $\frac{\$144}{\$750} = 19.2$ per cent interest on the investment.

Wiring and Illumination

DENVER CONCRETE POLE.

The accompanying illustration shows a concrete lighting standard, of which fifty will be placed by the Denver city government along a section of Seventeenth Avenue boulevard, twenty-five on each side at intervals of 100 ft. The

Concrete Pole Used in Denver.

standards are made of Portland cement, with an aggregate of Tennessee marble, and will carry a 75-watt series-tungsten lamps. The poles are made in Denver, and cost $20 apiece, exclusive of the ornamental bronze cap and the other details, which cost $16 additional.

INTERIOR WIRING SYSTEMS FOR FEDERAL BUILDINGS—II.

By Nelson S. Thompson.

In a previous issue a description was given of the interior-conduit work in federal buildings under the control of the supervising architect of the Treasury Department. The conduit work does not differ greatly from that required in regular practice nor does the wiring, but figures are given on wiring which if used in connection with an accurate bill of material for the job will give a close approximation of what such a job would be worth in the average federal building.

GENERAL ILLUMINATION.

The required light intensity for general illumination and the planes of illumination for the several classes of rooms are as follows:

GENERAL ILLUMINATION REQUIRED IN FEDERAL BUILDINGS.

Space.	Ft.-Candles.	Plane of Illumination.
Storerooms, machinery and boiler-rooms, corridors, halls, mailing vestibules, stairs	1.20	3′ above floor
Post-office workroom, lounging-room, offices, large toilet-rooms, large vaults	1.50 to 2.0	2′6″ above floor
Courtrooms, jury-rooms, money order and registry rooms, main lobby	2.0	
Civil service examination rooms	3.0	2′6″ above floor
Drafting-rooms	5.0 to 6.0	2′6″ above floor Drawing board
Other spaces are treated as special cases.		

The following table gives the lumens per watt per square foot for the lamps and reflectors generally used. The total watts required to produce this general illumination with this equipment is obtained from the following formula: Watts = floor area in square feet × by ft.-candles ÷ K.

LUMENS PER WATT FOR LAMPS AND REFLECTORS USED.

Lamps.	Walls.	K*.
Tungsten	Light	4.0
Tungsten	Dark	3.4
Carbon (3.1 w.p.c.)	Light	1.7
Carbon (3.1 w.p.c.)	Dark	1.4
Nernst	Dark	3.3
Mercury vapor	Large areas	6.6
Arc lamps	Large areas	3.0

*The value of K used is generally taken at 4 for tungsten lamps and light walls.

The above values apply to small and medium-size rooms. Very large rooms receive special consideration.

WIRING.

The standard wiring for lamp circuits in all buildings is three-wire feeders, three-wire subfeeders and two-wire branch circuits. In some cases this is varied to suit local conditions, as in a four-wire distribution system the four wires are brought to the main feeder tablet or switchboard and three-wire feeders run from this point to distributing cabinets.

The even-number wire sizes are used for feeders and subfeeders. In the smaller buildings as few wire sizes for feeders are used as is practicable. All branch lighting circuits are of No. 12 wire except circuits to special junction boxes on basement ceilings for furniture lighting, which are made of No. 10 wire.

The maximum allowance for branch circuits is 660 watts, except for circuits which supply a combination of outlets for general illumination and local illumination, in which case a maximum of 800 watts is installed; in this case, however, not more than three-fourths of the total watts supplies general illumination.

All lighting feeders and subfeeders (or mains) are calculated on the following basis: The assumed lighting load is the total watts for general illumination plus the total watts for local illumination (50 watts per receptacle) plus 1 watt per square foot of post-office workroom floor space. The load-factor for small buildings one to one and one-half stories high is taken as the full connected load for feeders and subfeeders. For buildings containing more than four distributing tablets the load-factor for feeders is considered to be 70 per cent of the connected load and for

subfeeder 80 per cent of the connected load. Subfeeders to workroom and court-room tablets are calculated for full load in all cases.

The voltage drop allowed is 3 per cent for feeders and 2 per cent for subfeeders. Feeders and subfeeders for all buildings containing not more than four distributing tablets are calculated on the basis of two-wire circuits and 110 volts. The wire size given by formulas is that of the neutral, and each outside wire is made one-half the neutral size, so that the systems may be used either for two-wire or three-wire service. No feeder or subfeeder wire is smaller than No. 8 and no single wire is made larger than 300,000 circ. mil.

In buildings containing more than four distributing tablets, if the supply is the usual 110-220-volt service, a straight three-wire system is used up to the distributing cabinets. The wire sizes are calculated for the outside voltage (220) and the neutral wire is made the same size as one of the outside wires. The feeders and subfeeders are calculated for full connected load and with 2 per cent drop in subfeeders and 3 per cent drop in the main feeder. The three wires of a three-phase circuit and the four wires of a two-phase circuit are all made of the same size and each conductor is of the cross-section given by the formula hereinafter stated. Branch circuits to single arc lamps are increased in size 50 per cent to provide for the extra current at starting.

The current-carrying capacities of all feeders and subfeeders at the load-factors given are not allowed to be less than specified in the National Electrical Code for rubber insulation, regardless of the voltage drop. This requirement will generally determine the wire size, but in all cases the voltage drop on feeders and subfeeders is calculated. As a rule, the drop is less than the allowed maximum in subfeeders 60 ft. long and under and in main feeders 100 ft. long and under.

WIRING FORMULAS AND TABLES.

The following formulas and tables are used by the Treasury Department in calculating wire sizes:

Circ. mils $= D \times W \times K \div P \times E^2$.

Volts lost $= P \times E \times B \div 100$.

Current in main conductors $= W \times T \div E$.

Where W equals total actual watts delivered; D equals distance one way in feet; P (a whole number) equals loss in line in per cent of W, that is, of power delivered; E equals voltage between main conductors at the lamps or motors, and K, B and T are constants the values of which are tabulated herewith.

VALUES OF K.*

System.	Per Cent Power-Factor.				
	100.	95.	90.	85.	80.
Single-phase	2,160	2,400	2,660	3,000	3,380
Two-phase (four-wire)	1,080	1,200	1,330	1,500	1,690
Three-phase (three-wire)	1,080	1,200	1,330	1,500	1,690

*K for direct current equals 2160.

The value of K for any particular power-factor, single-phase work, is:

$$K = \frac{2160}{(\text{power-factor})^2}$$

For three-wire, three-phase and for four-wire, two-phase work

$$K = \frac{2160}{2\,(\text{power-factor})^2}$$

The value of T depends upon the system and the power-factor. The constants for alternating-current circuits are based on wires spaced 18 in. on centers. The volts loss in conduit wire will be somewhat less than that given by the formula.

VALUES OF B.*

Wire Size.	25 Cycles. Power-Factor per Cent				40 Cycles. Power-Factor per Cent			
	95	90	85	80	95	90	85	80
0000	1.17	1.16	1.12	1.06	1.32	1.26	1.36	1.32
000	1.12	1.09	1.05	.99	1.24	1.26	1.24	1.19
00	1.08	1.04	.99	.92	1.18	1.18	1.14	1.09
0	1.05	1.00	.94	.87	1.13	1.11	1.06	1.01
1	1.02	.96	.90	.83	1.09	1.05	1.00	.94
2	1.00	.93	.86	.79	1.05	1.01	.95	.88
3	.98	.91	.84	.76	1.02	.97	.90	.83
4	.96	.89	.81	.74	1.00	.94	.86	.80
5	.95	.88	.80	.72	.98	.92	.84	.77
6	.94	.86	.78	.70	.97	.90	.82	.74
8	.93	.85	.76	.68	.94	.87	.79	.71
10	.92	.83	.75	.67	.93	.85	.76	.68

Wire Size.	60 Cycles. Power-Factor per Cent.				125 Cycles. Power-Factor per Cent.			
	95	90	85	80	95	90	85	80
0000	1.53	1.64	1.67	1.66	2.21	2.54	2.72	2.76
000	1.41	1.49	1.50	1.47	1.97	2.22	2.34	2.37
00	1.32	1.36	1.35	1.31	1.77	1.96	2.04	2.04
0	1.24	1.26	1.24	1.19	1.61	1.74	1.80	1.79
1	1.18	1.17	1.14	1.08	1.47	1.57	1.59	1.56
2	1.12	1.10	1.06	1.00	1.37	1.42	1.42	1.39
3	1.08	1.05	.99	.93	1.27	1.30	1.28	1.24
4	1.05	1.00	.94	.87	1.20	1.21	1.18	1.13
5	1.02	.97	.90	.83	1.15	1.13	1.09	1.03
6	1.00	.94	.87	.79	1.10	1.07	1.02	.96
8	.97	.89	.82	.74	1.03	.98	.92	.85
10	.94	.86	.79	.71	.99	.92	.85	.78

*B for direct current equals 1.

VALUES OF T.*

System.	Per Cent Power-Factor				
	100	95	90	85	80
Single-phase	1.00	1.05	1.11	1.17	1.25
Two-phase (four-wire)	.50	.53	.55	.59	.62
Three-phase (three-wire)	.58	.61	.64	.68	.72

*T for direct current is unity.

In direct-current circuits the volts drop per wire $= IR$ and the total volts drop $= 2IR$. I is the current per wire and R is the resistance in ohms per wire. In alternating-current circuits the volts drop depends on both the resistance and reactance; with wires close together, as in conduit work, the reactance will generally be small. However, for all alternating-current circuits the drop should be calculated at the assumed power-factor, load and corresponding current, using the following formula:

Volts drop per wire = ohmic volts $\times \cos \Phi +$ induction volts $\times \sin \Phi$.

$\cos \Phi$ = power-factor of the load.

Volts drop two-phase circuit = 2 (volts drop per wire).

Volts drop three-phase circuit = 1.73 (volts drop per wire).

In direct-current circuits the volts loss in per cent is the same as the per cent power loss. This is not the case in alternating-current circuits except at unity power-factor.

WIRE-SIZE DETERMINATION.

A convenient method of determining wire sizes is to ascertain first the current per wire and select a wire size which will carry this current, then to calculate the volts drop for the wire thus selected.

The power-factor of an unbalanced three-phase circuit is obtained from the following formula:

Power-factor = total real watts ÷ volts across lines × average amperes per phase × 1.73.

APPROXIMATE COST OF WIRING.

The average total cost of lighting systems complete in place in Eastern sections of the country is about $12 per outlet; in the West and South the cost will be about $15 per outlet, and in the extreme West the cost per outlet will be $20. The number of outlets upon which these figures

POWER-FACTORS OF VARIOUS LOADS.

	Per Cent.
Incandescent lamps	95
Arc lamps	70
Incandescent lamps and induction motors	85
Induction motors, full load	80
Induction motors, constant-speed type, starting	60
Induction motors, elevator type, starting	40

are based does not include switch outlets, but only the actual lamp outlets. In old buildings the cost of the conduit and wiring work is $20 to $25 per outlet and $30 in the extreme West.

When it is necessary to approximate closely the cost of the conduit and wiring system in a federal building the material is taken off accurately from the drawings and the figures given below are used.

The total amounts of conduit and wire are the lengths scaled on the plan plus the following: Number of ceiling outlets × 2 ft.; number of bracket outlets × 10 ft.; number of switch outlets × 10 ft.; number of baseboard outlets × 4 ft.; number of two-gang switches × 15 ft., and number of three-gang switches × 20 ft.

The average length of a branch run in federal buildings is 50 ft. The size of branch conduits is generally ½ in., and branch circuits are generally of duplex wire. For obtaining lengths of feeders a diagram is made of all feeder and subfeeder circuits.

COST OF CONDUIT IN PLACE (NEW BUILDING).

½-in. size	$8.50 per 100 ft.
¾ " "	10.25 " 100 "
1 " "	13.75 " 100 "
1¼ " "	18.25 " 100 "
1½ " "	22.00 " 100 "
2 " "	30.60 " 100 "
2½ " "	47.00 " 100 "
3 " "	60.00 " 100 "

Add 50 per cent to above for underground-service connections in place and for work in old buildings where walls and ceilings are cut and plaster must be replaced.

COST OF CONDUIT ELBOWS IN PLACE.

2 in. size	$ 1.00 each
2½ " "	1.25 "
3 " "	4.00 "
4 " "	10.00 "

The cost of all kinds of outlet boxes in place is 25 cents each in new buildings and 50 cents each in old buildings where plaster must be repaired. The cost of large junction boxes in place is 5 cents per pound; plug receptacles in place cost $1.30 each, and snap switches (single-pole, 10 amp) in place, $1 each. Fixture studs cost approximately 5 cents each in place.

Standard floor outlet boxes (such as are used in federal buildings) cost $3 each in place; telephone cabinets (such as are used in federal buildings) cost in place $20 each; outlet bushings, 5 cents each in place, and lock nuts, 1 cent each in place. One should estimate three bushings and three lock nuts per outlet. Reinforced silk-covered lamp cord (No. 16) costs approximately $55 per 1000 ft. in place, and knife switches, 250-volt, single-break, with extension for fuses unmounted, polished, cost as shown below.

COST OF DOUBLE-BRAIDED RUBBER-INSULATED WIRE (IN PLACE).

Size.	Cost per 1000 Ft.	Size Circ. Mils.	Cost 1000 Ft.
Solid Single Conductor			
16	$15.00	250,000	$275.00
14	18.60	300,000	327.00
12	21.70	400,000	405.00
10	25.85	500,000	500.00
Stranded Single Conductor		Duplex Conductors	
8	35.40	14	30.00
6	48.25	12	34.00
4	62.65	10	40.25
3	75.25	8	49.25

STRANDED SINGLE CONDUCTOR.

Stranded.	Single Conductor.	Stranded.	Single Conductor.
2	$82.00	00	$156.00
1	101.30	000	184.25
0	128.00	0000	217.00

COST OF KNIFE SWITCHES IN PLACE.

Rating.	Double-Pole.	Triple-Pole.
25	$ 1.80	$ 2.30
50	3.05	4.35
100	4.65	6.75
200	7.45	10.95
300	10.45	15.20
400	13.00	19.55
500	18.10	27.00
600	23.10	34.45
800	27.95	41.80
1,000	53.35	63.65
1,200	67.25	87.40

The cost of mounting, not including drilling of marble, is $1 per switch.

Inclosed fuses (in place) cost approximately as follows:

5 to 65 amp	.10 each
65 to 100 "	.25 "
110 to 200 "	.50 "
225 to 400 "	.90 "
450 to 600 "	$1.30 "

Other cost entering into a contract may be estimated as follows: Busbars for switchboards, 50 cents per pound, in place; structural steel work, in place, for switchboards, 10 cents per pound; blue Vermont marble, 2 in. thick, $2 per square foot; slate panels, 1¼ in. thick, 50 cents per square foot; drilling holes, slate and marble, 25 cents each; labor on switchboard panels in shop, $25, and on the job, $12 each; tablets and cabinets, complete in place, $5 per switch. One should ascertain if possible the actual cost of cabinets and tablets (which are special design) and add $1 per circuit for installation.

To this list may be added motor connections, 5 hp and under, $2 per horse-power; motor connections, 10 hp up, $1 per horse-power; freight and drayage, 3 per cent of total cost of material and labor; railroad fare, depending on location of the job; board and lodging, depending on location of the job; superintendence, 1 per cent of total cost of materials and labor, and profit, 20 per cent of total cost of materials and labor.

RECENT TELEPHONE PATENTS.

IMPROVED SWITCHBOARDS.

With the two-wire, common-battery, multiple-switchboard system the cut-off relay is usually operated upon a grounded circuit, being legged off to ground from the

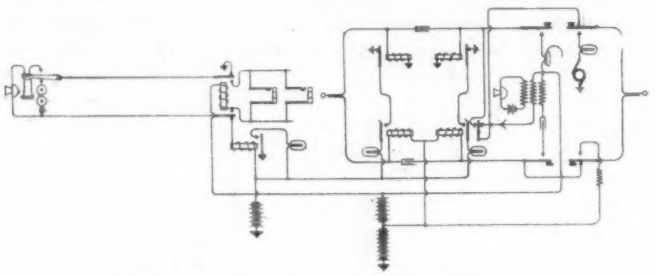


Fig. 1—Arrangement for Cut-Off Relay.

live or battery side of the circuit. The cut-off relay may, however, be arranged upon a metallic circuit basis, and this is done in the system patented by Mr. H. G. Webster, of Chicago. He uses independent batteries for the talking and cut-off relay circuits. These are oppositely poled and connected in series, the connection to one side of the cord circuit being made between them. The arrangement is shown in Fig. 1. The patent for this system has been assigned to the Kellogg Switchboard & Supply Company.

Mr. C. A. Simpson, of Chicago, has been granted a patent, which has been assigned to the same company, covering a switchboard system in which the cut-off relay is omitted. The jacks are provided with auxiliary contacts which break when a plug is inserted. The line lamp circuit is carried through all these in series.

A patent granted to Mr. H. J. Roberts, of Evanston, Ill., and assigned to the Homer Roberts Telephone Company, describes the key and circuit system necessary to control party lines equipped with his selective signaling system.

To the Dean Electric Company have also been assigned two patents issued to Mr. F. B. Allen, of Elyria, covering trunk circuits with automatic ringing features. There is also included a busy back feature to indicate when the called-for line is in use.

RINGING SYSTEM.

The usual ringing systems require the use of an alternating-current generator. In the system patented by Mr. F. R. Parker, of Chicago, direct current suffices. A biased polarized ringer is arranged in series with a condenser. Auxiliary make-and-break contacts are associated with the

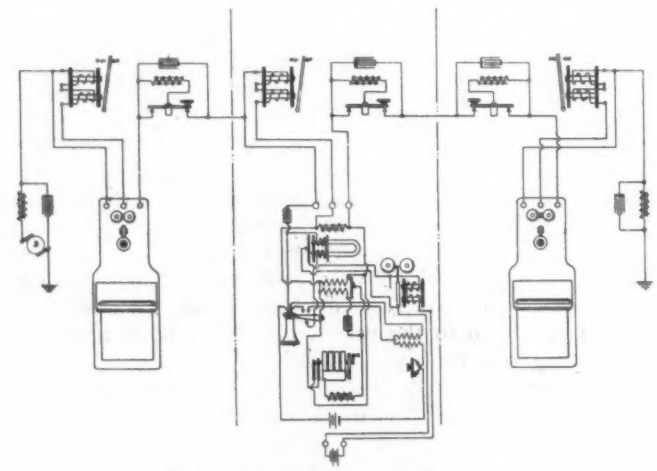


Fig. 2—Relay Arrangement for Dispatch System.

ringer armature. The ringer is poled so that the bias spring assists the pull, corresponding to current from the battery as normally connected. If the battery connections be reversed from normal a momentary rush of current takes place as the condenser in series with the ringer is charged. Driving the interval of its auxiliary contacts the ringer moves to such a position that the condenser is connected directly across the ringer. The discharge and bias spring together drive back the armature, when the process is repeated until the normal connection of the battery is restored.

IMPROVEMENTS IN DISPATCH SYSTEMS

The use of selectors upon dispatch systems is now quite common. These selectors pick out the desired station to the exclusion of all others. Mr. J. F. Graf, of Scranton, Pa., has extended this application to the selection of a branch line. The connection of the branch line is effected through a relay, the circuit of which is in turn closed when the main line selector is set in the required position.

The combined telegraph and telephone line is concerned in a patent granted to Mr. O. M. Leich and assigned to the Cracraft-Leich Electric Company. Fig. 2 shows the arrangement, which includes a high-frequency calling generator and a howler signaling instrument for telephone calling signals.

DESK STAND.

Mr. N. Pedersen, of Genoa, Ill., has patented a desk stand, the improvements in which lie wholly in details of construction to facilitate manufacture. All auxiliary parts such as induction coil, switch springs and terminal block are carried upon a metal spider within the base piece. A cushion ring is arranged upon the bottom and the base cover piece is secured by a slight angular twist by the use of buttons and buttonholes.

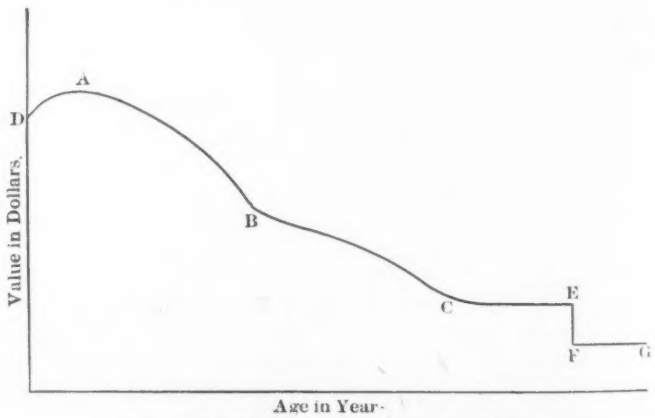
LETTERS TO THE EDITOR.

Depreciation.

To the Editor of Electrical World:

Sir:—I have read with interest the criticism of my article on "Depreciation" in your issue of Aug. 5 by Mr. W. A. Del Mar and Mr. Frank F. Fowle.

Mr. Del Mar raises the question of the meaning of the word "value" and how it is measured. Those who have had occasion to think broadly upon the meaning of this word will agree with me that it may mean almost anything reasonable, depending upon the circumstances, and can be measured in dollars, diamonds or wampum or even in that intangible thing called "good will." I agree with him that "utility" is what is really meant, and in view of the fact that we must necessarily work with practical things and



Curve Showing Depreciation of Apparatus.

actual physical apparatus how shall we measure utility unless it be in dollars? After all, things are only relative and have magnitude only with respect to each other. Under certain conditions it is just as easy to measure

weight with a yardstick as with a pair of scales, and in many engineering works it is easier. For example, the weight of a flywheel once installed can be measured by a yardstick near enough for many practical purposes when it would require considerable labor and expense to weigh it. The point is that while money may not be the correct measure of utility, it is the nearest to a correct measure that we know of and will be used as such until some one brings out something better.

Replacing the words on the curve "value in dollars" by the word "utility," the curve still holds true in the average case, but not in every case. The sharp corners at *E* and *F* are explained by the fact that at a certain time in the life of every piece of apparatus it changes from a useful machine to an inert mass of scrap metal. That is, its utility becomes zero, although it still has value. This change takes place suddenly in most cases. For example, the writer is now installing a new pump to do the work of one that has been used for twenty years and is both practically worn out and obsolete by virtue of inefficiency. The old pump will be left in its place for an indefinite time as a reserve unit, and by slightly stretching the imagination it is possible to see that there will be a time when this old pump will suddenly be converted from a useful machine to scrap in the course of about two hours' time. This condition accounts for the sudden drop in the curve and for some of the "corners and kinks."

While I have stated that the curve shown represents the usual history of the average piece of apparatus, I agree with Mr. Fowle that, as a practical thing, under certain conditions, the use of the straight-line method of depreciation is reasonable. This I believe to be true more on account of the uncertainties of prediction regarding the future history of apparatus than because of the philosophy of the thing. In other words, the introduction of a new machine may and often does completely upset the reasonableness of the whole matter, so that the best a utility can do is to charge off to depreciation a conservative amount from income based on the straight-line method. In using depreciation in connection with appraisals, whether the sinking-fund method or the straight-line method should be used depends upon the past history.

I note by reading Mr. Henry Floy's discussion of my article that I seem to have conveyed the impression that I believe that all apparatus follows the curve shown. The table of actual experience given in the same article emphatically shows this is not true. The curve is given to show the history of what might be termed the average piece of apparatus, and in practical use must be modified by conditions. It is a sort of foundation on which to build depreciation curves. In certain cases various parts of the curve are entirely changed. As Mr. Floy states, much apparatus has no increase in value after installation. In many cases there is no reserve period, represented by *BC* on the curve, and in some cases no period represented by *CE*. I would therefore emphasize the fact that the curve is intended to be the general curve for depreciation, to be modified according to the judgment of the engineer in specific cases.

Ft. Atkinson, Wis. H. G. D. NUTTING.

Acuity in Monochromatic Light.

To the Editor of Electrical World:

SIR:—I have been exceedingly interested in reading Mr. Luckiesh's valuable article in your issue of Aug. 19 on the difference in visual acuity found between monochromatic light and that covering a considerable range of the spectrum. I am particularly glad to have my own investigation of the matter checked by other observers and by a totally different method, leading, as it theoretically should, to substantially the same results. Mr. Luckiesh's figures show plainly the immense advantage of monochromatic light when it comes to the simple matter of defining power. The method he adopted does not, of course, show the difference between monochromatic light and the continuous spectrum at its worst. Since his absorbing screens limited the range of radiation from the continuous spectrum to about half that corresponding to an unscreened incandescent source, this lessened range of radiation, of course, rendered the acuity observations somewhat more difficult; but the result is none the less striking. I particularly admire the success with which he succeeded in getting comparisons with the sodium line and I hope he will be good enough to publish the method by which he got the requisite steadiness. I must, in the most friendly way, take exception to Mr. Luckiesh's somewhat careless remark to the effect that I had assumed the mercury tube to be monochromatic. On the contrary, I described the mercury spectrum at some length and what I said about the monochromatism of the light was this:

"In a strict technical sense the light of the mercury-vapor lamp, like that of the flaming-arc lamp, is far from being monochromatic, but so far as effective luminosity goes the spectrum of the former is perhaps the closest approximation to monochromatism of the light of any commercial illuminant."

This statement I do not think anybody would be inclined to dispute, and in addition it is undoubtedly true that for the line 0.546μ and the pair 0.578μ the focal surfaces in the eye are so nearly coincident that it would be difficult to determine any difference in acuity based on so small a quantity.

Also, while I am gratified that Mr. Luckiesh adopted a method of experimenting which in no way involved the question of heterochromatic photometry, I am strongly of the opinion that one makes no mistake in assuming the substantial correctness of the flicker method where heterochromatic comparisons have to be made—that is, if in a heterochromatic comparison there is a substantial difference between the results obtained with the flicker instrument and with an equality-of-brightness photometer it is altogether probable that it is the latter which is in error. Dr. Ives' admirable experiments merely showed that with instruments presenting identical fields of sufficiently strong illumination the flicker and equality-of-brightness methods could give practically coincident results. That they do not give such results when one considers the general case of flicker photometers as compared with equality-of-brightness photometers is a fact which has been too long familiar to photometrists to admit of a discussion. Moreover, when there is a substantial difference between the results the equality-of-brightness instrument varies from the flicker always in one direction.

Finally, as regards my comment on the measurements of Broca and Laporte this difference was actually found to exist in following their method of equality-of-brightness determination, which happened to give results particularly aberrant as compared either with the flicker photometer or with a Lummer-Brodhun screen. However, this comment does not detract from the value of Mr. Luckiesh's beautiful experiments nor from the neatness of the method he adopted for avoiding any conceivable objection which might be raised to the use of heterochromatic photometry in solving this particular problem.

Apropos of his experiments with Dr. Ives' visual acuity screen, it may be worth mentioning that Hastings has shown (*American Journal of Science*, Vol. XIX, 1905, page 203), both from his own experiments and those of Dr. Wolf, that the dispersion of the lens of the human eye is greater than that of ordinary crown glass. Hence the combination with a concave spectacle lens would not tend to be achromatic. As all the observers wore spectacles it is probable that part of the difference between their re-

sults in this particular experiment may have been due to the fact that in prescribing glasses the oculist, however skilful, has to make his corrections for the best average conditions considering the particular errors of the eye with which he has to deal. Hence spectacles often do not give the full theoretical correction for a particular reading distance, and the distance of 1 m used in this case, lying as it does between ordinary distant vision and ordinary reading vision, would be quite certain to show residual errors enough to disturb acuity measurements.

Boston, Mass. Louis Bell.

Loading of Telephone Circuits.

To the Editor of Electrical World:

Sir:—A perusal of the article in your issue of July 15 by Messrs. Samuel R. Parker and J. Cavers entitled "Notes on the Loading of Telephone Cable and Open-Wire Circuits" indicates that the authors appear to have an erroneous conception of the theory of "neutralizing" the effect of capacity in telephone circuits by the introduction of lumped inductance in accordance with the Pupin system. On page 167 the authors compute the inductance necessary to "neutralize completely" the capacity of a circuit at 800 frequency. They do this as though the capacity and the inductance were simply lumped in a series circuit and speak of the impedance of the circuit as being equal to

$$\left[R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2\right]^{\frac{1}{2}}$$

As is well known, this method of computing the line impedance does not apply to a circuit containing capacity and inductance distributed along its length in the manner of a loaded telephone circuit.

At the bottom of the second column on page 167 the authors start out with a line 1200 miles long having a total attenuation of 3.96, and determine the attenuation constant necessary on a 1600-mile circuit, in order that the latter may have the same transmission efficiency—that is, the same total attenuation. An arithmetical mistake in the solution of this problem of simple proportion gives them a resultant attenuation constant of 0.00284 instead of 0.00248, or a total attenuation for the 1600-mile circuit of 4.5—that is, a value greater than the figure 3.96 with which they started. Without apparently noticing this inconsistency the authors attempt to explain the result by a process of reasoning which leads them to the remarkable conclusion that ". . . . thus, although loading improves the articulation, it reduces the volume of sound, or the amplitude; and as the value of R_e increases with the inductance of the coils, it will be readily seen that, if a line is overloaded or loaded more than absolutely necessary to get the standard of transmission required, the efficiency of the circuit is reduced instead of increased for long-distance transmission." Continuing, the authors state that for a value of $\beta d = 4.60511$ or $e^{-\beta d} = 100$, the limiting point at which loading is commercially of value has been reached. No explanation of these particular figures is given and apparently the only reason for determining the value of βd to six significant figures is to make $e^{-\beta d} = 100$. Later in the paper they give a "practical" value for βd of 4.1446 and use this value in the preparation of Fig. 1. This value, which is exactly 10 per cent less than the theoretical value quoted, is given with five significant figures, although the authors state that ". . . . but in practice this value has to be reduced approximately 10 per cent to allow for extraordinary losses, such as leakage, eddy currents and hysteresis losses, which exist on the circuit, but which *cannot be calculated.*" (The italics are mine.)

New York. Frank B. Jewett.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Pendulum Converter.—E. Falkenthal.—An illustrated description of a new type of pendulum converter for transforming direct current into alternating current, especially for purposes of telephone stations. The main feature of this type is that there are no condensers required as in other similar designs. The construction is shown in Fig. 1, the direct-current circuit from a storage battery being shown at the top and the alternating-current circuit at the bottom. By the motion of the pendulum the left-hand and the right-hand halves of the circuit are alternately connected to the circuit. The pendulum is moved by the attraction of a permanent magnet bar at the top moving in an artificial stray flnx of the transformer core. The necessity of using condensers in order to prevent sparks when contacts are broken is avoided in the following way: Before the contact of the pendulum with the left-hand half of the coil (as in the moment represented in the illustration) is broken the right-hand half is connected in parallel with the left-hand half for a very short time. Since the two halves of the coil are identical but wound in opposite directions an opposite emf is induced and the primary current is reduced for a moment to zero, so that there will be no spark when the contact between the pendulum and the left-hand half of the coil is broken. The mechanical method of making the parallel connection is clearly shown in the illustration. The time during which the two halves are connected in parallel can be adjusted by means of the large screws illustrated. The proper position of these screws can be found by using an ammeter in the primary circuit and adjusting the screws until the ammeter shows a minimum of current. For this position sparking at the contact is a minimum and the alternating-current wave

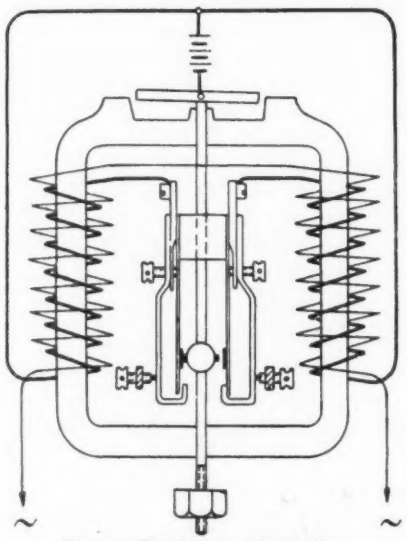


Fig. 1—Pendulum Converter.

produced has the most favorable form.—*Elek. Zeit.*, July 20.

Grinding Carbon Brushes.—A note on a recent British patent of Mr. A. Watkins (17,236, Aug. 10, 1911). A

machine for grinding the contact surface of dynamo brushes is provided with a rocking frame with inclined sides and carried by a spindle. The spindle is mounted in side frames supporting a cross-piece which carries a wooden block with a curved surface to correspond to that of the commutator. One end of the spindle is fixed to a handle for rocking the frame to and fro, and over the block a sheet of glass paper is placed and fixed by clamps at each end of the frame. The brushes are held in a fixed position by carriers attached to the center of the side frames and are adjusted to the desired angle by a pivoted plate holding the same. This may be set to any angle by a rod engaging with radial slots formed in the carriers and fixed by screw nuts. The grinding is effected by working the handle backward and forward.—Lond. *Elec. Eng'ing*, Aug. 17.

Lamps and Lighting.

Chromoscope Measurement of Colors.—LEO ARONS.—An illustrated description of a new instrument which permits one to produce any tint of mixed colors and to define it numerically. The simple chromoscope consists of two Nichol prisms P and A (Fig. 2). Between these two prisms quartz plates Q of different thickness, cut perpendicularly to the crystallographic main axle, can be inserted. Diffused white light from a porcelain disk is thrown through the circular hole B, through the lens L, onto P. Observation is made from R. Instead of the white disk a colored one is seen. The color depends on two quantities; first, the thickness of the quartz plate Q, and, second, the angle between the plates of polarization of the Nichol prisms A and P. This angle may be read directly from a dial. Six quartz plates are used in thicknesses of 0.25 mm, 0.5 mm, 1.0 mm, 2.0 mm, 4.0 mm and 8.0 mm respectively and mounted in brass plates arranged one after the other. Each brass plate has two identical holes. One hole is filled with a quartz plate, the other is empty. By sliding any of the brass plates to the side any number of quartz plates can be arranged one after the other so that it is possible to adjust the total thickness of the quartz plates from 0.25 mm to 15.75 mm in steps of 0.25 mm. The different colors are produced by reason of the fact that the rays of different wave-length contained in white light, after their passage through P, undergo different deflection of the planes of polarization in the quartz plates Q and, therefore, pass more or less weakened through A. In contradistinction to the colors of the spectrum, mixed colors are here obtained. A still greater variety of mixed colors can be obtained by using two sets of prisms and quartz tubes in series. For this purpose the end of the tube between B and x in Fig. 2 is taken off and the piece from B' to y in Fig. 3 is substituted for it. The white light enters through B', passes through L', is polarized in P', so that after the different deflection of the planes of polarization of the different colors in Q' a colored light is now made to pass through the quartz plate Q. The author thinks it is sufficient to use for Q' always one and the same plate; he has employed a quartz plate Q' of 3.75 mm. With this arrangement the colors in the composite chromoscope are measured by three figures; first, the thickness of the quartz tube Q; second, the angle between the prisms A and

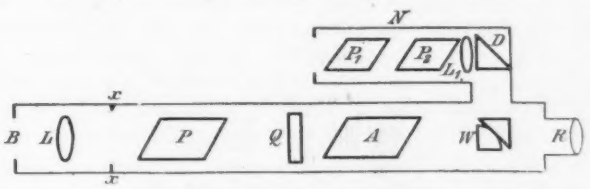


Fig. 2—Simple Chromoscope.

P, and, third, the angle between the prisms P and P'. As shown in Fig. 2, a Lummer-Brodhun photometer cube may be inserted at the point W. It permits the colored image to pass through the circular contact surface while the free hypothenuse surface sends toward R the rays which are thrown to it from the side tube N by the totally reflecting prism D. The side tube is parallel to the main tube. Besides the lens L_1 it contains the two Nichol prisms P_1 and

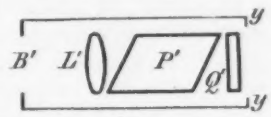


Fig. 3—Addition for Composite Chromoscope.

P_2, of which P_1 can be rotated, and the angle of rotation can be measured by means of a circular dial. The side tube is directed toward a white porcelain disk which is placed at the side of the other white porcelain disk from which white diffused light is sent into the main tube. Both white porcelain disks are identical and equally illuminated. The lens L_1 is so chosen that the colored image from the main tube, which is observed through R, appears surrounded by a concentric ring. By rotating the Nichol prism P_1 equal illumination of both surfaces is produced while all quartz plates are removed. In this case the boundary line between the inner circle and outer ring disappears. This is the normal position in which the color determinations are made, especially the choice of the colors which serve as standard colors. If the white porcelain disk for the side tube is replaced by a surface of a certain color (a colored paper or cloth) the central picture of the image in R can be made to assume the same color by adjusting the quartz thickness Q and the angles between A and P and between P' and P. The color tint is, therefore, determined by these three figures. For determining the color of transparent bodies (glass or solutions) the glass is placed directly before the side tube and the solution, held in a suitable absorption vessel, is also placed directly before the side tube, which is again directed toward a white porcelain surface. Then the adjustments are made again in the main tube. The chromoscope can also be used for determining the color tint of a source of light. For this purpose the normal position is first obtained while both surfaces are illuminated by the same standard light. Then the standard light is screened off from the white porcelain disk before the side tube and this disk is now illuminated by the lamp the color tint of which is to be determined. Then the angles between the prisms and the thickness of the quartz plate are adjusted until equality is reached again.—*Elek. Zeit.*, July 27.

Impregnated Carbon Electrodes.—J. ESCARD.—An article giving a review of the history and properties of impregnated carbon electrodes for arc lamps. The following effects of impregnation are first discussed: Greater steadiness of the arc; increase of luminous efficiency; prevention of slag formation, and adjustment of the color tint of the arc. Inconveniences of impregnated electrodes are then taken up, namely, the effect on electrode consumption and the production of fumes. Finally the manufacture of impregnated electrodes is briefly discussed.—*L'Industrie Elec.*, July 25.

Generation, Transmission and Distribution.

First 110,000-Volt Plant in Europe.—E. G. FISCHINGER.—The first part of a long illustrated description of the transmission system from the main plant of the Lauchhammer metallurgical works to two other plants of the same company and for the supply of energy to the district around the towns of Grossenhain, Oschatz and Meissen in Saxony. There is a mine of bituminous coal at the Lauchhammer works, but formerly it was found more advantageous to ship the coal to the two other plants of the company than to transmit electrical energy. Since the demand for power has increased rapidly, recalculations have shown that an electric transmission system would be far more economical. When this had been decided upon an arrangement was made by which the three towns mentioned above, instead of erecting their own central station,

will buy up to 12,000 kw for thirty years from the company. This will be supplied to the towns in the form of 60,000-volt and 15,000-volt energy, and will be metered as such. For transmission a voltage of 110,000 is to be used, which is the highest thus far employed in Europe. The generating station will contain four three-phase turbo-generators, each of 5000 kw rating, at a power-factor of 0.8 and a voltage of from 4740 to 5500. For the present only three of the generators will be installed. The article is to be concluded.—*Elek. Zeit.*, Aug. 17.

Turbines.—F. Prasil.—An abstract of a paper read at the Zurich meeting of the (British) Institution of Mechanical Engineers on the results and experiments with Francis turbines and tangential (Pelton) turbines. Within the last ten years the Francis turbine and the Pelton wheel in the most varied forms of construction have quite taken the place of the older types, such as the Jouval and Girard turbines. Capacities as high as 16,000 hp in single units have now been reached. The Francis turbine is applied with success to falls of from 1 m to 150 m (3.3 ft. to 492 ft.), the Pelton wheel to falls from 40 m to 950 m (131 ft. to 3116 ft.). In this progress is to be noted not only a steady improvement in the details of construction of the turbine, but also in the efficiency of the automatic governing and the safety mechanism. Particularly in modern plants with long supply pipes and conduits, with their severe specifications for high-standard reliability in the safety apparatus, these requirements make large claims upon the skill and ability of the engineers. The result has been, however, a large measure of success in the production of successful designs. In regard to efficiency, much further advance in the future is not to be expected. The problem of governing can be considered as not yet completely solved, since there still appears in view a series of applications which would influence the further development of this problem. The electrification of railways might be mentioned as one example.—Lond. *Electrician*, Aug. 11.

Water-Power Plants in Switzerland.—An account of the recent Swiss tour of the (British) Institution of Mechanical Engineers and its convention at Zurich. (Abstracts of the papers presented at this meeting have been or are given elsewhere in the Digest.) At the city of Basle a 2000-kw steam turbo-generator has been added to the steam plant, while large extensions of the water-power plant near by are about to be completed. Ten km (6 miles) above Basle, between the towns of Augst and Wyhlen on the south and north side of the Rhine, the river is completely dammed, giving a gross fall of from 5 m to 8½ m (16 ft. to 28 ft.), with mean 6.7 m (22 ft.), to ten Francis turbines of 15,000 hp total on the south, or Swiss, side and to other ten turbines on the German side yielding about the same total horse-power. The turbines are direct-coupled to three-phase, 1600-kva generators on horizontal shafts with periodicity of 50 and speed of 107 r.p.m. From the south side the energy is taken to Basle at 7000 volts—that is, without transformation. On the north side part of it is raised to 45,000 volts and transmitted over six aerial lines, while four other lines transmit the rest without transformation. Another excursion was made to the Rheinfelden works (rating, 17,000 hp) and the Laufenburg works (50,000 hp). The manufacturing plants of the Brown-Boveri Company, of Escher, Wyss & Company and of the Oerlikon works were also visited. Excursions were made to the Rhine Falls near Schaffhausen, to the Schaffhausen hydroelectric power plant and the plants at Lontsch and Beznau.—Lond. *Elec. Review*, Aug. 11.

Colliery Power Plant.—J. Burns.—A paper read before the South Staffordshire and Warwickshire Institute of Mining Engineers in which the author compares the advantages of gas and exhaust steam for colliery power plants. His conclusions are generally in favor of exhaust steam. He contends that the maximum of simplicity with economy is obtained in the average existing colliery by improving the steam conditions of the winders and utilizing the exhaust to drive a low-pressure turbine. These plants are absolutely independent of each other. The winders are under the absolute control of the drivers and are run under exactly the same conditions whether the turbine is running or not. The power supplied by the turbo plant, whether the transmission medium be electricity or compressed air, will drive all the underground plant in addition to the outlying plant on the surface, and, finally, the turbines use all the low-pressure steam available to its utmost advantage and automatically use only as much extra high pressure steam as is required to make up the exact output.—Lond. *Electrician*, Aug. 11.

High-Tension Transmission in Spain.—M. Neustätter.—The conclusion of his illustrated article on the transmission system of the Hidroelectrica Española Company and its Molinar power plant. The most remarkable features of the system are the voltage of 70,000 and the distance of the different cities which are supplied with energy from the plant. These distances are 254 km (152 miles) to Madrid, 80 km (48 miles) to Valencia, 82 km (49 miles) to Alcoy and 180 km (108 miles) to Cartagena. The first two lines are in operation, the latter two in course of construction. In the present instalment the construction of the line, the protective devices, the substations and the telephone system are described, and an account of the opening of the system is given. The whole tramway system of the city of Madrid is supplied with energy from the plant 254 km away.—*Elek. Zeit.*, Aug. 3.

Hydroelectric Plant in Silesia.—An article giving notes on various plants in the province of Silesia in Germany, with special reference to the Weistritz dam, from which water is to be supplied to a plant containing three 600-hp turbines, of which one is used as reserve. For transmission voltages of 10,000 and 30,000 are used. The furthest distance is 70 km (42 miles). The plant is to operate in conjunction with the large steam-power plant at Waldenburg, which furnished last year about 22,000,000 kw-hours. —*Elek. Zeit.*, July 27.

Traction.

Manchester Municipal Railways.—An abstract of last year's account of the municipal railway system of the city of Manchester, which is quite successful financially. The annual contribution in relief of the rates has shown a tendency to increase from year to year. The amount paid over for this purpose for the year ended March 31, 1911, was $375,000, bringing the total contributions during the last ten years to $2,635,000. The number of passengers carried shows a greater increase than for several years past; the total of 165,800,077 represents 184 journeys per year per head of population served (approximately 900,000). The number of car-miles was 17,367,200, as against 17,161,774 a year ago, the number of passengers per car-mile having risen from 9.26 to 9.55. The total number of kw-hours used was 29,063,006, or 1.673 per car-mile, compared with 1.709 in the previous year. As regards the financial results, the average traffic revenue per car-mile was 22.086 cents, as against 21.738 cents last year. The working expenses were 64.08 per cent of the receipts and amounted to 14.348 cents per car-mile. The average fare paid per passenger was 2.32 cents, as against 2.34 cents a year ago. The parcels department of the tramways continues to make progress. The number of parcels carried in 1911 was 950,000, the receipts $50,000 and the total profits from this department $12,000. The total expenses, including capital charges, etc., per car-mile were 18.12 cents, the total revenue from all sources 22.70 cents, hence the balance is 4.58 cents. Of this 2.38 cents was used for reserve, renewals and depreciation fund; 0.12 cent for street improvements, and 2.08 cents represented the contribution to the city in aid of rates.—Lond. *Electrician*, Aug. 11.

Rack-Railway Locomotives.—T. WEBER AND S. ABT.—A paper read at the Zurich meeting of the (British) Institution of Mechanical Engineers. The authors describe the various railways in Switzerland which are operated either wholly or partially on a rack system. Details of both the steam and electrically worked lines are given.—Lond. *Electrician,* Aug. 11.

Electric Traction on European Main Roads and Interurban Roads.—F. STEIN.—Continuation and conclusion of his very extensive and elaborate statistical tables. Switzerland has eight direct-current, six single-phase and two three-phase roads; England, fourteen direct-current and two single-phase roads; Italy, eight direct-current, five single-phase and two three-phase roads; Norway, one direct-current and two single-phase roads; Sweden, two single-phase roads; Holland, one direct-current and one single-phase road; Belgium, one single-phase road, and Spain, one single-phase and one three-phase road. For each road a very large amount of statistical information is given.—*Elek. Zeit.,* Aug. 10 and 17.

Installations, Systems and Appliances.

Rates for Electrical Energy.—E. WIKANDER.—A paper read before the German Association (Verband) of Electrical Engineers. In view of the great importance of the metallic-filament lamp to central stations the author thinks that the rates at present in use should be revised. This is also necessary in view of the increased importance of electric cooking and heating apparatus. He recommends the introduction of a special price from 2 cents to 2.5 cents per kw-hour for cooking; an extra discount of from 5 per cent to 10 per cent for residences in which only electric light is used; a flat rate with a limiting device (which limits the maximum power which can be taken from the supply mains), but without meter, preferably in a way similar to a rate recently introduced in the city of Bremen. The price difference of $3.75 and $5 between the cost of a meter and a simple limiting device may be usefully employed for paying the cost of installation of the first lamps for small consumers. A new rate may be introduced in which energy is furnished for cooking at a very low price which could otherwise not be obtained. The consumer should have a free choice between different rates. In general the price of energy should be reduced. The introduction of lighting by electricity should be facilitated in the same way as this is done for gas by making installations free of charge, etc., so that in the competition between gas and electricity, which in itself is sound and desirable, electricity should not be held back artificially.—*Elek. Zeit.,* Aug. 3.

London Central Station.—An abstract of last year's financial report of the St. Marylebone electricity supply plant. The total sales of electrical energy during the year have increased by 14.5 per cent over the previous year, the figures for last year being 9,152,000 kw-hours for private lighting, 1,398,000 for public lighting and 1,788,000 for motors and heaters. The average price received was as follows: For private lighting, 7.652 cents per kw-hour, and for motor service, 2.954 cents, the average for the whole of the private supply being 6.88 cents. The load-factor during the last year was 16.9 per cent as against 15.7 per cent in 1909-10, 14.5 per cent in 1908-9 and only 11.8 per cent in 1906-7. The total operating cost last year, including generation, distribution and management costs, but not including capital charges, was 2 cents per kw-hour sold. The total capital charges were 4.46 cents, hence the total cost was 6.46 cents, while the total revenue was 6.92 cents.—Lond. *Electrician,* Aug. 18.

Electrophysics and Magnetism.

Nature of Light Action in Selenium.—F. C. BROWN.—An account of an experimental investigation, the chief results of which are as follows: Light produces two changes of opposite sign in the conductivity of all light-sensitive selenium. The amount of the change is a function of the time of illumination as well as the intensity and character of the illumination. The character of the conductivity curves for the four known varieties of light-sensitive selenium can be explained by assuming the existence of three components in dynamic equilibrium, under given illumination, temperature, pressure and electric potential differences. The effect of any agency that affects the conductivity of selenium is of such a nature that it alters the rates of interchange between the components. The experimental results can be explained to a first order approximation on the assumption that only the B kind is conducting of the three components which are in equilibrium according to the reaction $A \leftrightarrow B \leftrightarrow C$. If the view thus proposed is accepted the failure of Ohm's law becomes only an apparent and not a real failure.—*Phys. Review,* July.

Number of Electrons in Metallic Conduction.—J. W. NICHOLSON.—The electron theory of the conduction of electricity through metals, first developed by Drude, has in the hands of later investigators been placed on a firm footing. However, no certainty exists as to the number of free electrons which must be supposed to be present in the atoms of the various metals at ordinary temperatures in order to account for their optical properties. In the present highly mathematical paper the author attempts to discriminate between certain hypotheses with the aid of experimental results. While the present paper is only preliminary it would appear that the exact number of free electrons per atom in a metal can be determined and results can be obtained which may tend toward a comprehension of the structure of the atoms of the elements. Thus five free electrons seem to be attached to every two atoms of silver, while an atom of manganese seems to have three free electrons and it is possible that a solid magnesium molecule contains seven atoms and has twenty-two electrons to spare.—*Phil. Mag.,* August.

Electric State of the Upper Atmosphere.—A. J. MAKOWER, W. MAKOWER, W. M. GREGORY AND H. ROBINSON.—An account of a great many experiments in which the electric state of the air at different heights above the ground was investigated by means of kites and balloons during three summers. The authors conclude that results of considerable interest are obtainable by the methods employed. The problems of atmospheric electricity are, however, so complicated and seem to depend on so many conditions that there is little hope of arriving at an understanding of the different influences at work by intermittent experiments. It is thought that continuous observations will enable one to separate the effects of barometric pressure, temperature, humidity and wind velocity respectively.—Lond. *Electrician,* Aug. 18.

Units, Measurements and Instruments.

Units of Resistivity.—D. ROBERTSON.—A letter with reference to the recent article of Dellinger. The author criticises the laxity in definition and notation of the units of resistivity. He considers the following two to be the best definition: Resistivity is that property of the material in virtue of which it converts energy into heat when an electric current flows through it, and it is measured by the resistance per unit length of a rod (or wire) having a unit cross-section. The mass resistivity is measured by the resistance per unit length of a rod (or wire) having unit mass per unit length. Instead of ohms per centimeter-cube, one should speak of ohm-centimeters, etc.—Lond. *Electrician,* Aug. 18.

Vibragraph.—An illustrated description of an instrument which permits one to record and measure all kinds of vibrations. The instrument is shown in Fig. 4. A mercury cup is provided with a floating mirror, so pivoted as to avoid lateral movement, and the mercury ripples caused by vibration result in an angular movement of the mirror.

The beam of light emanating from a small incandescent lamp and reflected by the mirror records on photographic paper a straight line if the vibration is in one plane only, or a complex figure if the vibration be in planes at different

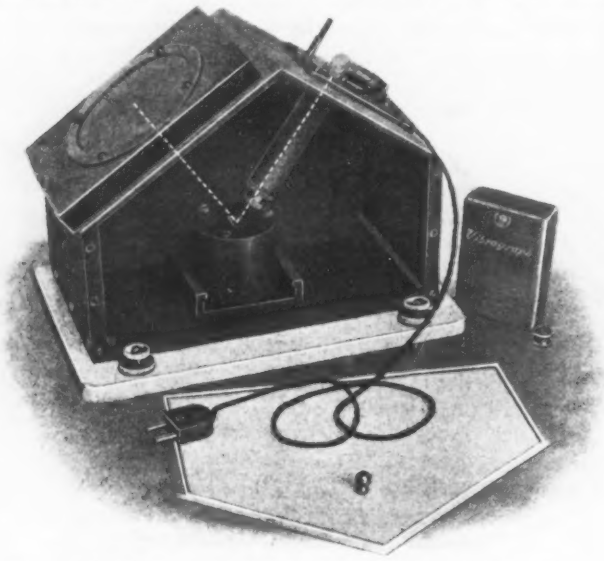


Fig. 4—Vibragraph with Side and Lamp Cover Removed.

angles, such as is nearly always the case in actual practice. When no records are required the photographic paper can be replaced by a screen, thus permitting of direct visual observations. Each mercury cup has its own constants, and three different cups are usually supplied with the instrument so as to make the vibragraph suitable for recording strong (say, 0.3 mm), medium (0.08 mm) and small (0.02 mm) vibrations. With each cup is supplied a set of calibration curves which permit of the determination from the photographic record of the actual movement of the vibrating body in fractions of inches or millimeters. Fig. 5 shows a typical vibragram obtained from the crank casing of an engine driving a 1250-kva alternator at 188 r.p.m. The apparatus has been used in practice in connection with litigation in respect of alleged nuisance through transmitted vibration of central stations.—Lond. *Elec. Review*, Aug. 18.

Measurement of Magnetic Fluxes.—P. Sève.—An abstract of a paper presented before the French Academy of Sciences on the measurement of magnetic fluxes in absolute value. For this purpose either electrodynamic or induction phenomena may be used. The method most employed is that of the Cotton balance. But it is nevertheless useful in all cases to compare the results of the balance with the results of ballistic measurements. The author gives results of the two methods used in combination.—*L'Industrie Elec.*, July 25.

Measuring the Fluctuations in a Rapidly Varying Re-

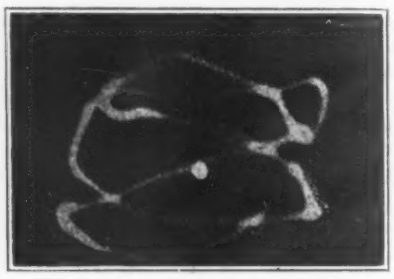


Fig. 5—Crank Casing of Engine Driving 1250-kva Alternator at 188 R.P.M.

sistance.—F. C. Brown and W. H. Clark.—Sometimes it becomes necessary to measure a variable resistance which changes during short intervals of time. By placing the resistor of variable resistance in one arm of a Wheatstone bridge circuit the average resistance can be expressed for any interval of time in terms of the throw of a ballistic galvanometer where the galvanometer is thrown into the circuit by means of a pendulum for the desired interval of time, which must be small compared to the period of the galvanometer. How small this interval should be is also determined by the rapidity with which the resistance changes. If the time is made sufficiently short the average resistance practically becomes the actual resistance at the middle of the interval.—*Phys. Rev.*, July.

Optical Pyrometry.—C. E. Mendenhall.—An illustrated paper in which the author describes a convenient mounting, a method of calibrating the spectroscopic eye-piece for the Holborn optical pyrometer, and gives a comparison of the "spectroscopic" and "red-glass" temperature scale which justifies the use of Wien's law with the ordinary "red-glass" form of pyrometer.—*Phys. Review*, July.

Localization of Faults in Cables.—A brief description of an instrument made by a German company which permits one to read off directly the distance of a cable fault in meters from the point where the test is made. The apparatus contains a storage cell and the instrument proper, which operates according to the voltage-drop method.—*Elek. Zeit.*, Aug. 3.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—An article in which the author gives results of work of the Bellini and Tosi wireless compass on board ship.—Lond. *Electrician*, Aug. 18.

Miscellaneous.

German Association of Electrical Engineers.—The first parts of a full stenographic report of the business sessions of the recent convention of the German Association (Verband) of Electrical Engineers. The discussions which followed the presentation of the different papers are also reported in full. (The papers themselves are not included in the report, but are printed separately. Abstracts of the different papers have been given, or will be given, in the Digest.) The official addresses of welcome and the presidential address of Prof. E. Budde on the present status of electrical industries are given in *Elek. Zeit.*, July 20. The annual report of the secretary, Mr. G. Dettmar, gives a review of the work of the Verband and of the different committees during the year. The finances are in satisfactory condition, there being a surplus of $6,500 for last year.—*Elek. Zeit.*, July 27. Further committee reports, as well as the discussions of papers by Nowak on a machine for calculating wiring networks, by Eppner on the safety of insulating materials against fire, and by Kesseldorfer on mercury motor meters, are given in *Elek. Zeit.*, Aug. 3. The very extended discussion of Ossanna's paper on the design of single-phase commutator motors is given in *Elek. Zeit.*, Aug. 10.

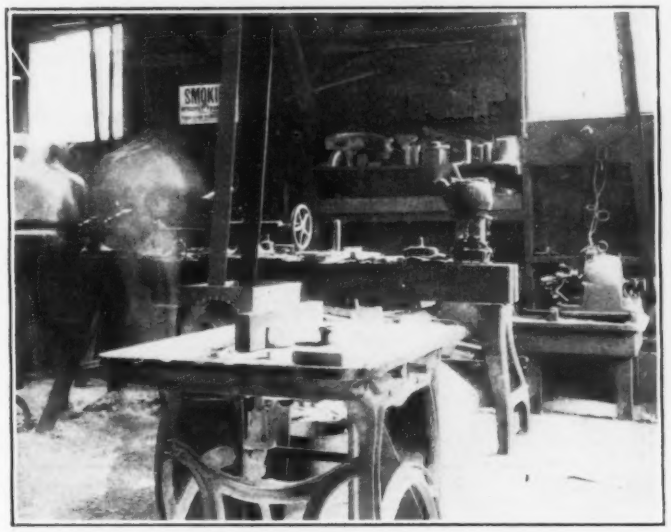
Patent Attorneys.—C. Weihe.—The author gives a history of patent attorneys in Germany and the laws which regulate their activity. These laws are criticised, and recommendations for their amendment are made. The position of the patent attorney is thought to be midway between that of the engineer and that of the lawyer.—*Elek. Zeit.*, Aug. 3.

Exhibition of Instruments.—J. Saphores.—The conclusion of his long illustrated description of various exhibits at the recent exposition of the French Physical Society. J. Carpentier exhibited ohm standards of manganin wire; the Abraham-Villard electrometer for measuring directly continuous or alternating-current emf of the order of magnitude of 200,000 volts to 800,000 volts; a new design of the Ricardo Arno galvanometer; the Abraham frequency meter; an induction wattmeter; an angular speed indicator, and the Abraham rheograf without iron. Mr. J. Richard exhibited various laboratory instruments, a recording wattmeter for automobiles, and a recording milliammeter for thunder storms.—*L'Industrie Elec.*, June 10.

New Apparatus and Appliances

FIFTEEN-YEAR-OLD MOTOR IN A PATTERN SHOP.

It is in the service of the relatively small industrialist that electricity often proves its value and demonstrates the dependability of electrical apparatus in general, where the inability to fulfil a contract through interruption of machinery operation may mean the failure of the firm with meager capital. In a corner of the pattern shop here shown there will be seen in operation a motor which has been in constant service every day for fifteen years, being in fact the first Wagner motor sold in St. Louis. The motor is of 2 hp running on 110-volt alternating current at 1800 r.p.m. and has never received or required any attention other than that of the shop hands. That there still remain possibilities along the line of electrification in this special instance is evidenced by the use of the oil-heated glue-pot. The service supplied by the motor should prove a good talking point for the adoption of an equally serviceable electrically heated outfit.



Fifteen-Year-Old Motor.

RECENT IMPROVEMENTS IN DISTRIBUTING TRANSFORMERS.

About three years ago marked improvements were embodied in the "type S" transformer developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. They consisted principally in a radically new shell design of magnetic circuit whereby low magnetic reluctance is obtained without increasing the mean length of turn of the winding, and which was especially adapted for the use of the new silicon steel for the magnetic circuit. These improvements resulted in a marked increase in efficiency, better regulation and a reduction in exciting current, all important characteristics. Notwithstanding the radical changes made at that time, development of the same type of transformers has continued and several marked improvements have been recently announced.

These recent improvements have resulted from improved materials and better mechanical design. The subject of insulation has been given special attention, as upon this the life of the transformer largely depends. The insulating materials now used are of better quality both mechanically and electrically, with the result that a further increase in efficiency and reduction of exciting current has been obtained. For example, the 7½-kva transformer, which formerly had an iron loss of 62 watts and copper loss of 125 watts, now has only 57 watts iron loss and 110 watts copper loss. The exciting current has been reduced from 2.2 per cent to 1.7 per cent and the regulation at 100 per cent power-factor improved from 1.69 per cent to 1.55 per cent. Other sizes show corresponding improved performance.

A very uniform temperature is maintained throughout the entire transformer and in no place does the temperature rise exceed 50 deg. under normal conditions. This insures long life and high all-day efficiency. In line with the question of insulation, the high-tension coils have been further subdivided to reduce the voltage between layers of the windings as well as between coils and thus relieve the strain on the insulation. A view of the improved coil is shown in Fig. 1.

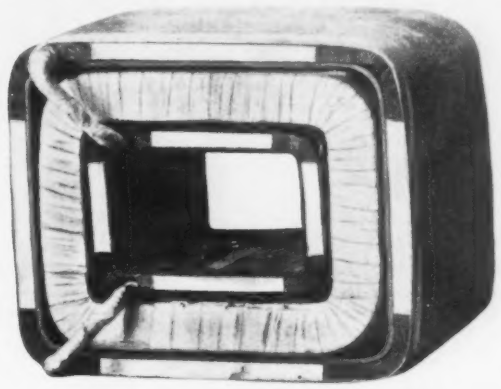


Fig. 1—Improved High-Tension Coil.

Slight changes have also been made in the terminal bushings to insure no possibility of grounding to case due to the collection of dust between the bushing and the case and still further to make the siphoning of oil from the case impossible. The new bushing is shown in Fig. 2.

A highly flexible weatherproof cable is used for the leads, which are rubber-insulated with a grade of rubber that would deteriorate very slowly if exposed to the weather. The rubber insulation is protected by a braided covering and the cable meets the rigid new requirements of the National Board of Fire Underwriters, which some of the cables now used on transformers do not.

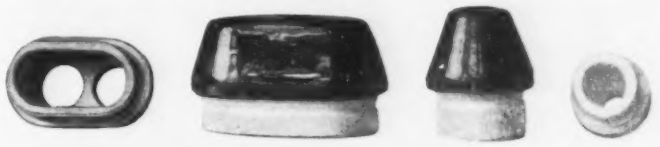


Fig. 2—Terminal Bushings.

"DIELECTRITE" INSULATION.

Announcement is made that the Staunton Dielectrite Rubber Company, of Muskegon, Mich., has completed a new plant to be devoted to the manufacture of Dielectrite, a molded insulation for high-tension and low-tension electrical work. This material is the invention of Mr. Gray Staunton, who has been conducting experiments for a

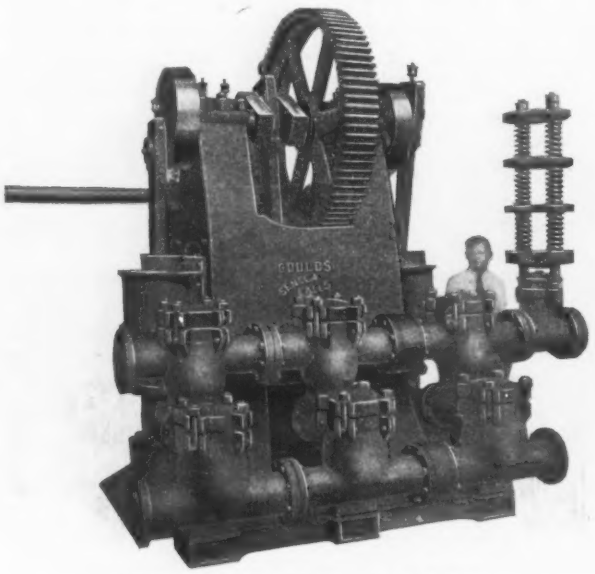
number of years in a laboratory in Chicago. The material has the appearance of hard rubber and is usually black in color, although it can be produced in various tints. The exact composition of this insulating substance is not revealed, but it has been said that the greater part of it is made up of vegetable fiber, the remainder being of mineral origin. The ingredients are mixed and milled into the consistency of a hard gum and the mass is then placed in a mold and subjected to great pressure in a hydraulic press. While subject to this pressure it is vulcanized by the application of heat and it emerges in shape designed for electrical use.

Various types of insulators and insulating devices are made from this material, such as petticoat insulators, bus-bar supports, oil-switch tubes and bushings for switchboard work. Dielectrite is said to possess great dielectric strength and to show an excellent resistance to heat. It does not absorb moisture and is not easily attacked by acids or alkalis. It may be molded to nearly any form desired and easily machined. Accurate threads may be formed on the inside or outside of tubes made of this material. The specific gravity of this substance is only about 1.31 and it is not brittle or friable and possesses reasonable mechanical strength.

Dielectrite has been used for insulators on lines carrying 44,000 volts and over. It is said that about $100,000 has been expended on experimental work relating to this interesting insulation during the last twelve years. During this time comparatively small quantities of material have been produced and it has been used to a considerable extent in the substations of the Commonwealth Edison Company and also in other electrical installations in Chicago.

SINGLE-ACTING TRIPLEX PLUNGER PUMP FOR HIGH PRESSURES.

The Goulds Manufacturing Company, Seneca Falls, N. Y., has just placed on the market a new high-pressure triplex power pump. The pump is similar to the type which is in general use in mines, waterworks and with hydraulic elevators, fire-protection systems, hydraulic presses, oil-pipe lines, etc., the chief difference being in the gearing. As shown by the illustration, the new pump



High-Pressure Triplex Power Pump.

has only one gear and pinion, which are located between the standards. Placing the gearing in this manner necessarily lengthened one side of the pump somewhat and increased the distance between the two valve boxes on that side. Instead of lengthening the pipe connection between the valve boxes on one set and making each set of a different shape, as they are in many pumps, a distance piece is put in as shown.

By making use of this arrangement the three sets of valve boxes are kept identical in form and interchangeable. This duplication of parts, which is a feature of Goulds pumps, saves valuable time when repairs are needed and also reduces the number of parts kept in stock by the user, who may be located a great distance from the manufactory.

MERCURY-ARC RECTIFIERS FOR FIRE-ALARM SYSTEM.

The use of mercury-arc rectifiers and storage batteries in connection with fire-alarm systems tends to effect a marked reduction in operating expenses. The new system

Fig. 1—Old Battery for Fire-Alarm System.

installed in Plymouth, Pa., by the Dugan Engineering Company, of Wilkes-Barre, Pa., is an interesting example. The old system consisted of a battery of seventy-three bluestone cells; the new comprises forty-four storage-battery cells and a General Electric mercury-arc rectifier

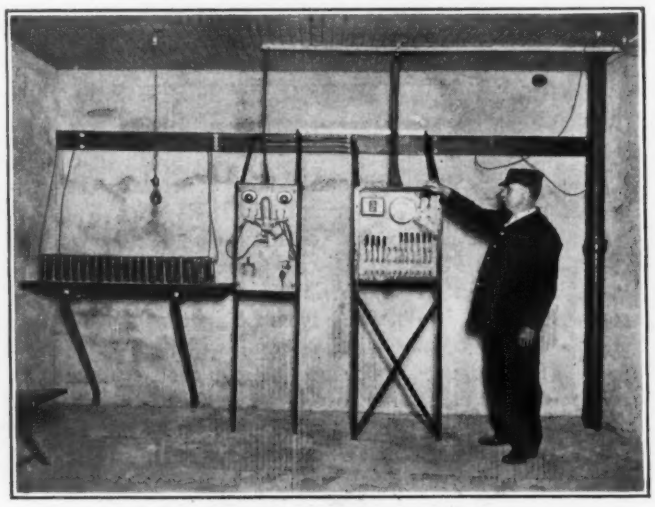


Fig. 2—New Battery Equipment for Fire-Alarm System.

for converting alternating-current supply into direct-current for the battery. The cost of operating the old system was $15.30 per month, while the cost of the new is $1.35 per month.

750,000-VOLT TESTING TRANSFORMERS

Two 500-kva, 750,000-volt testing transformers have recently been built at the Pittsfield works of the General Electric Company, one of which transformers is for permanent use at the Pittsfield factory, where it will aid particularly in the research and investigation of corona and other phenomena in connection with transformers, oil circuit-breakers, insulators, etc.

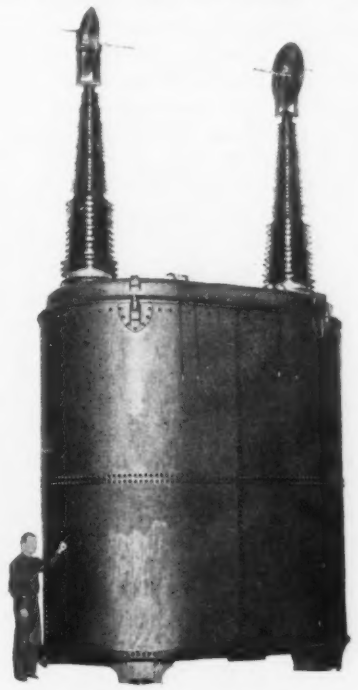


Fig. 1—750,000-Volt Testing Transformer.

The transformers are oil-insulated and follow an adaptation of the vertical-core type used generally on high-voltage transformers. The low-tension winding consists of long cylindrical coils placed next to the core on each leg. The high-tension winding consists of a number of double-section circular-disk coils with conductor wound one turn per layer. The terminal coils, which are at the top of each stack, have smaller outside diameters than the coils lower down, so that greater distance is provided between these coils and other parts.

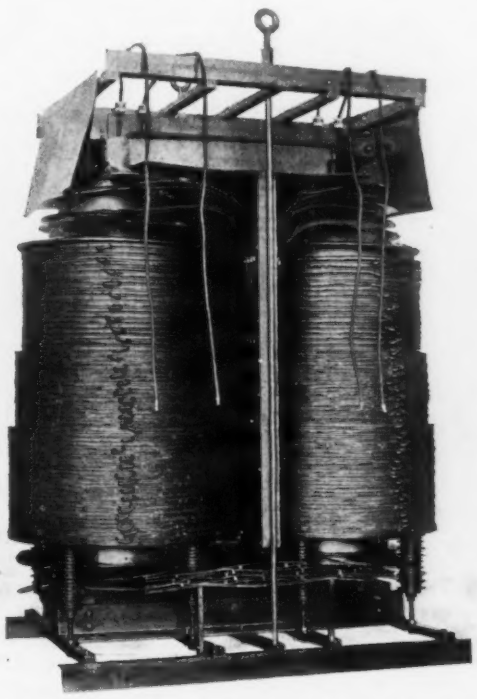


Fig. 2—Core and Coils of 750,000-Volt Testing Transformer.

The insulation between high-tension and low-tension windings consists of a number of pressboard cylinders which divide the space into a number of generous oil ducts greatly assisting in the circulation of oil and increasing the dielectric strength. The insulation between the two stacks of high-tension coils consists of a number of flat pressboard barriers with oil ducts between. The insulation material used is especially treated to give high insulation resistance and low specific capacity.

The supports for the high-tension coils are unique in that they consist of metal upon which the winding directly rests and to which they are electrically connected. These metal supports act as shields to the terminal coils, protecting them from any discharge which may be induced to ground. While there is a metal shield at both the top and bottom of each stack, the windings are supported only at the bottom, where the metal shield rests upon heavy porcelain insulators attached to the iron framework of the transformer.

The tanks are constructed of heavy wrought iron with riveted seams and are provided with substantial cast-iron feet. The cover is of cast iron. Both high-tension and low-tension leads are brought out through the transformer cover. The low-tension leads follow the usual construction of flexible leads passing through porcelain bushings. The high-tension leads are of the sectional filled type, which consists of rings of insulating material filled with a semi-viscous compound. To obtain sufficient creeping surface on the outside of the leads collars are assembled between the annular sections.

Tests for corona have been taken at night with the transformer operated at normal voltage by ratio, both high-tension terminals being free. While the protective reactances on the top of the high-tension leads showed considerable corona, very little was noted elsewhere on the transformer or leads.

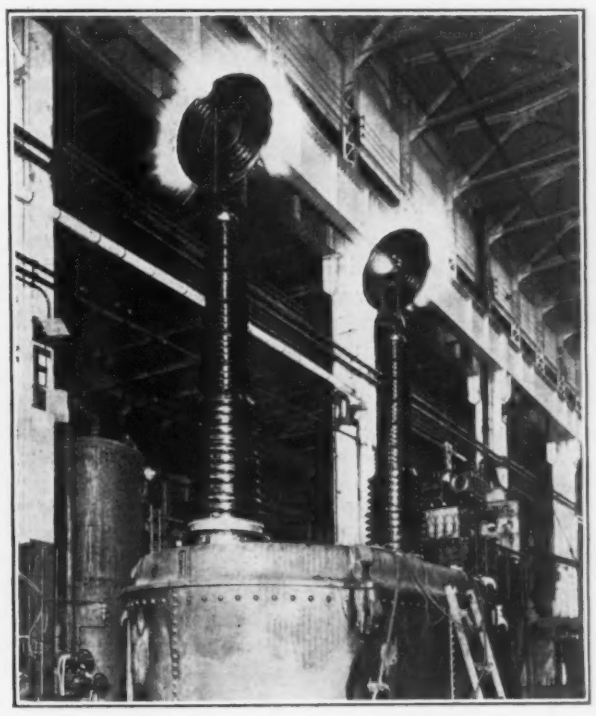


Fig. 3—Corona Tests at 600,000 Volts.

The approximate weights and dimensions are as follows: Floor space, 8 ft. x 13 ft.; height to top of cover, 15½ ft.; Total height, including protective reactances and spark-gap, 28 ft.; weight of core, 13,150 lb.; weight of copper, 1100 lb.; weight of tank and cover, 14,000 lb.; total weight less oil, 28,250 lb.; weight of oil, 50,400 lb. (7000 gal.).

PRIVATE ELECTRIC AND PUMPING PLANT.

On the estate of Mr. Thomas E. Proctor, near Topsfield, Mass., is to be found one of the most complete and best-arranged private plants in New England. The power plant proper is located in one corner of an attractive building, the other divisions of which serve as garage and

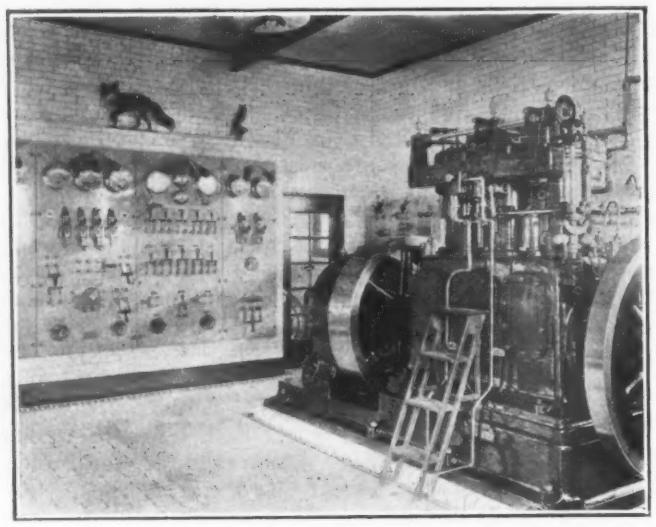


Fig. 1—Generating Set and Switchboard.

machine repair shops. In this small section of the building the energy for the lighting and water supply of the entire estate is generated and stored. The main unit consists of a 40-hp, four-stroke-cycle Westinghouse gasoline engine direct-connected to a generator. The estate is provided with an ample private water supply pumped to a reservoir located on the top of a hill 180 ft. above the level of the springs and then distributed by gravity to the various service pipes of the house and the estate. This reservoir has a capacity of 100,000 gal.

The pumping equipment is installed in the basement of the building under the power room. The pump is of the vertical, triplex, single-acting type made by the Goulds Manufacturing Company, Seneca Falls, N. Y., and has a rating of approximately 132 gal. per minute. The pump is driven by a 15-hp motor mounted on the pump base. A rawhide gear meshes with the driving pinion of the pump and insures practically noiseless operation. The motor and pump, having a capacity of about 200,000 gal. of water per day, occupy a floor space measuring but 7 ft. x 4 ft. and are placed between the engine foundation and the foundation of the building. The motor is so wired that it may be run either directly from the generator or from storage batteries. The battery when fully charged will deliver enough energy to operate the pump for eight hours continuously, during which time about 65,000 gal. of water will be forced into the reservoir. The triplex pump at times operates at practically a zero suction lift, although the source of water is several feet below the intake end.

This zero suction head is obtained by a device which provides for the use of a sand and vacuum pump. The sand and vacuum chamber is a steel cylinder 6 ft. long and 3½ ft. in diameter which is located just beyond the pump between the generator foundation and the foundation of the building. The intake pipe from the pump is coupled to this cylinder at the center of its nearest end and a 2-in. pipe leading from the top connects with a Goulds motor-driven vacuum pump. As a partial vacuum is created by the operation of the suction pump, the water from the springs is supplied to the sand chamber above the level of the intake pipe of the triplex pump. The water is automatically kept within certain limits above its outlet pipe, the triplex pump and the vacuum pump interacting automatically so that the one cannot suck air and the other cannot pump water. This automatic interaction is obtained by a ball float operating two tumbler switches to which it is connected by means of a set of chains, pulleys and weights. This float is located in the sand chamber and operates a few inches from the top. When it is desired to pump water into the reservoir the operator throws a single switch that starts either the triplex pump or the vacuum pump, depending upon the level of the water in the sand chamber. Assuming that this latter was left nearly full when the pump was last stopped, the closing of the electric circuit will start the 15-hp motor and the triplex pump, and this will continue to operate as long as the water in the sand chamber remains at a certain level above the intake pipe of the pump. If the level of the water in the sand chamber is lowered 11 in. without inducing a sufficient suction to draw from the source of supply, the large ball float will have dropped to the point at which its lever will release a 5-lb. weight attached to a tumbler switch. When the weight pulls this switch down another electric circuit is closed which serves to start the 2-hp motor driving the vacuum pump. The same lever arm that closes this small switch releases another 5-lb. weight connected to a second tumbler switch.

This action opens the switch in question and serves to stop the 15-hp motor and triplex pump. As the level of the water in the sand chamber at which this action occurs is well above the outlet pipe, the triplex pump is stopped automatically before it can draw air. As the vacuum is formed in the sand chamber, the level of the water rises, the float moves upward, and when the extreme of its travel is reached the two weights are raised by the lower arm and the small switch is opened and the large switch closed. This serves to stop the vacuum pump and start the triplex pump again which, now having a full tank from which to draw, will continue to operate until the level of the water is again reduced or until a sufficient supply has been

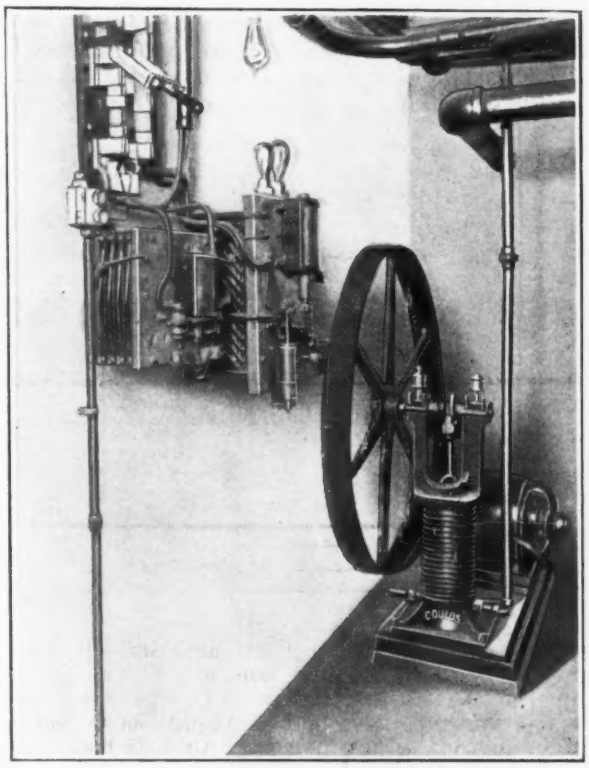


Fig. 2—Motor-Driven Vacuum Pump and Control Apparatus.

pumped into the main reservoir. The vacuum pump and switches are located in the corner of the basement pumping-room, across from the triplex pump, and the two machines are connected by the operating chains that control the switches. The sand tank is designed to be tight under a 29-in. vacuum.

Industrial and Commercial News

THE WEEK IN TRADE.

OWING to approach of harvesting, advancement in general business is more pronounced in the Middle West and Southwest than elsewhere in the country. Actual contact with the crops is causing an optimistic tone in these sections, and it is expected that the volume of fall business will be close to the average, on account of low stocks and the spread of the buying movement. Confidence is not fully established in the East, and new business is due in a large measure to the approach of the autumn season. Numerous opinions on the state of trade concur in the statement that conditions are sound, but none suggest the stimulus that is needed to infuse vitality in business at this time. There has been a small increase in distribution of actual necessities, but retail trade cannot be regarded as anything but quiet. Buyers are more numerous in the various markets, but they are proceeding very cautiously, and show no disposition to buy in large amounts. Prices are wavering in the steel trade. A cut of $1.00 per ton made by one of the independent companies last week was met by the larger producers, including the Steel Corporation, and similar reductions are expected in other steel products. In its statement of unfilled orders as of Aug. 20, issued late last week, the Steel Corporation recorded larger tonnages in August than in July. Business with the independents is fair, but all of the steel mills are working well below capacity, although present output is favorable, referred to the average of the past few years. There are many scattering orders for equipment of various kinds, but there are no large orders in sight. Labor difficulties are a retarding influence at this time, and the outcome of the Union Pacific case is awaited with strong interest. In view of the large number of disturbing elements, advancement must necessarily be slow. Business failures for the week ended August 31 as reported by *Bradstreet's* were 164, as compared with 198 for last week, 179 for the corresponding week in 1910, 166 in 1909, 210 in 1908, and 130 in 1907.

THE COPPER MARKET.

CONSUMERS were not especially interested in the market last week, and placed only a few orders, most of which were for small amounts. The majority of melting interests continued to await developments in the price situation, and showed little concern over the present position of the market. The stocks in the hands of many consumers are being increased by deliveries on contracts placed earlier in the season, and since these supplies are apparently adequate for present needs in view of the dullness in general trade, consuming interests can afford to withhold purchases at this time, and by so doing, strengthen their position in the market. Efforts of the producers to create a buying movement resulted in lower prices in the latter part of August, but the concessions were small, and met little response. Although the official price of the United Metals Selling Company is 12⅝ cents, sales of electrolytic for thirty days' delivery were made at 12.55 cents in the latter part of the week, and many agencies are willing to contract for September business at this figure. As is usual, the trade is expecting improvement to follow announcement of the Copper Producers' report and the August report will be of more than ordinary interest, for it will be the first issued since expiration of the curtailment agreement between the larger producers on the first of the month. Foreign business was good throughout the month, and will contribute largely to the tone of the August statement. Exports during the month were 27,976 tons, and for the year ended August 31, were 222,620 tons as compared with 280,118 tons during the corresponding twelve months ended August, 1910. For the current month, including Sept. 5, exports aggregate 3914 tons. The daily call on the Metal Exchange, Sept. 5, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.15	....
August	12.00	12.15	12.07½
September	12.00	12.15	12.07½
October	12.00	12.15	12.07½
November	12.00	12.15	12.07½

The London market, September 5, was as follows:

	Noon. £	s.	d.	Closing. £	s.	d.
Standard copper, spot	55	18	9	56	0	0
Standard copper, futures	56	11	3	56	12	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.35			11.57½		
London, spot	57	10	0	53	7	6
London, futures	58	2	6	54	0	0
Best selected	61	10	0	57	5	0

INDUSTRIAL AND COMMERCIAL NOTES.

H. M. Byllesby & Company Interested in Southern Combination.—It is learned that H. M. Byllesby & Company are the Chicago capitalists interested in effecting the combination of Southern utilities mentioned in these columns last week. They have offered the stockholders of the Louisville Gas Company $120 a share for their holdings, and the directors of the company have recommended that the offer be accepted. It is likely that the deal will go through, including the transfer of the stock held by the city, amounting to a little over one-third of the entire outstanding stock. The interest which the situation holds for electrical men lies in the fact that this is believed to be the forerunner of a movement to combine the public service corporations of Louisville, including the electric companies. Such a plan has been discussed and attempted heretofore, but for various reasons has failed. It is believed locally that if the deal goes through it will likely mean the joint operation of the Louisville Lighting Company (control of which is held by the Louisville Gas Company and would pass to the new owners of the latter in the event of a sale), the Kentucky Electric Company and the George G. Fetter Lighting & Heating Company. Another gas company, the Kentucky Heating Company, would also be affected.

Officers of Chicago Elevated Railways.—Under the reorganization of the executive staffs of the elevated railways of Chicago, due to the combining of the companies by the organization known as the Chicago Elevated Railways, in which Samuel Insull, as chairman of the executive committee, is the guiding spirit, a full list of officers for each of the three constituent companies (Northwestern, Metropolitan and South Side) has been chosen. Each of these operating companies has elected the same set of officers, and the list is as follows: President, Britton I. Budd, formerly president of Metropolitan; general manager, E. C. Noe, formerly of Northwestern and Chicago & Oak Park; treasurer, William V. Griffin, formerly of Northwestern and Chicago & Oak Park; secretary, P. D. Sexton, formerly of Metropolitan; assistant treasurer and assistant secretary, E. C. Adams, formerly of South Side; auditor, T. B. MacRae, formerly of Metropolitan. The Chicago & Oak Park Elevated Railroad Company was not taken into the combination directly, but it is controlled by the Northwestern Elevated Railroad Company, which is in turn controlled by the Chicago Elevated Railways.

Westinghouse, Church, Kerr & Company.—Present engineering and construction engagements of Westinghouse, Church, Kerr & Company include the following shop work: Chesapeake & Ohio Railway, at Silver Grove, Ky., thirteen-stall roundhouse, power house, planing mill, storehouse, pumping plant for delivering 1,000,000 gal. per twenty-four hours from Ohio River, coaling station, fuel tank, water tank; Chesapeake & Ohio Railway, at Summit, Ohio, five-stall roundhouse, power house, storehouse, sand house, water tank and cinder pit; New York, Ontario & Western Railway, at Middletown, N. Y., erecting shop with complete crane service; alongside of erecting shop, a low bay with crane for heavy machine tools, addition to power house and equipment, tunnels and yard piping, necessary yard wiring and other miscellaneous works.

Northwestern Power Development.—J. A. Coram, of Boston, has announced that a Massachusetts syndicate will spend some $6,000,000 in developing 80,000 hp in Kootenai Falls, Mont., for distribution to the mining districts and other localities in western Montana, northern Idaho and northeastern Washington.

Government Ownership of Telegraph a Burden on British Taxpayers.—In discussing the commercial aspects of telegraph operation by the British government, the *Spectator* says that the working cost per thousand words telegraphed in Great Britain to-day, is more than it was thirty years ago. It states further, that the incapacity of the British government to conduct a business enterprise has been demonstrated in this instance, beyond all question. These charges are substantiated by statistics showing that not only was the $35,000,000 paid for the lines at the outset, in 1869, more than three times the original estimate, but in addition to this cost, the government had to pay another $20,000,000 to railroad companies for right of way, making a total first cost of $55,000,000 upon which interest charges have not been earned in the past thirty-nine years. The deficit has been paid from the treasury, entailing a loss upon the taxpayers. When this condition had been experienced for some time, rates were reduced upon the belief that increased business, with larger profits would result, but the change had the opposite effect. Under government ownership, costs of operation and maintenance have been enormous, and, including the original cost of the lines, which has never been repaid, advances by Parliament upon which no interest has been charged, and the annual deficits in operating expenses, the commercial loss to the country through purchase of the telegraph is close to $170,000,000. There is no disposition to regard the government control as an asset, since each year's operation brings an additional loss of over $5,000,000.

Westinghouse Orders.—Recent orders for railway equipment received by the Westinghouse Electric & Manufacturing Company include the following: City & Country Contract Company, of West Chester, N. Y., for an 80-ton switching locomotive with quadruple equipment of motors and control; from the Morris County Traction Company, Morristown, N. J., for fifteen double-equipment motors, with control; from the Hutchinson Interurban Railway Company, of Hutchinson, Kan., for one double equipment of motors, with control; from the New York, New Haven & Hartford Railroad Company, one 80-ton central-control switching locomotive with four motors and unit-switch control, and fourteen 80-ton switching locomotives, with quadruple motors and "HL" control; from the Denver & Intermountain Railway Company, Denver, Col., for two quadruple equipments of motors, with control; from the Portland, Grey & Lewiston Railway Company, Lewiston, Maine, for one 35-ton locomotive, with quadruple motors and control; from the Richmond & Henrico Railway Company, Richmond, Va., one motor equipment, with control; from the Springfield Traction Company, Springfield, Mo., for six double-equipment motors, with control; from the Sapulpa & Interurban Railway Company, Sapulpa, Okla., for one double-motor equipment, with control; from the Trenton, Bristol & Philadelphia Street Railway Company, Trenton, N. J., for two motors, with control, and from the Lehigh Valley Transit Company, Allentown, Pa., for four quadruple motors, with control.

Gainesville (Fla), Gas & Electric Power Company.—Charles W. Morse, of Haverhill, Mass., president of the Gainesville Gas & Electric Power Company, of Gainesville, Fla., has asked the Superior Court of Massachusetts to issue an order restraining the State Street Trust Company, of Boston, from foreclosing a mortgage which is secured by bonds of the Gainesville Gas & Electric Power Company. The plaintiff alleges that seven bonds valued at $3,500, which were pledged to him by George I. Doig, vice-president and secretary of the Gainesville Company to secure a loan, were taken wrongfully from the company's office last April. The foreclosure proceedings were undertaken at the request of present holders of these bonds. Mr. Morse, who owns over half of the stock and bonds of the company, claims that the company is solvent and is doing a profitable business, and states that the party accused of taking the bonds is now under indictment in the Circuit Court of Florida. An order of notice returnable Sept. 7 was issued by the court.

August Incorporations Below Average.—In the month of August papers filed in the Eastern States for companies with an authorized capital of $1,000,000 or over, including increases in capital, aggregated $87,350,000. This is a decrease of $106,000,000 as compared with July, and $20,150,000 as compared with the total in August, 1910. Charters taken out during the month by other companies, with a capital of $100,000 and over, including states other than those in the East, made a total capital of new incorporations of $144,509,000, a substantial decrease as compared with $361,820,000 in June, and $194,520,500 in July last year. The total incorporations for the present year of companies with an authorized capital of $1,000,000 or over was $1,334,662,000 as of Aug. 31, as against $1,564,212,400 for the corresponding period in 1910.

British Columbia Electric Railway Company, Ltd.—C. C. Moore & Company, of Seattle, Wash., have been awarded a contract by the British Columbia Electric Railway Company, Ltd., of Vancouver, B. C., for the extension of the company's auxiliary steam-power plant. The original steam-power plant of the company was installed by this concern. The approximate expenditure for the new work will be about $250,000, and the terms of the contract call for completion by Dec. 18, 1911. The new equipment includes four Babcock & Wilcox boilers, each of 500 hp, and one 2000-kw Allis-Chalmers turbo-generator, with condensers, piping, etc. With this additional equipment the capacity of the steam auxiliary plant will be 12,000 hp.

Exhibits for Traveling Engineers.—At the recent Chicago convention of the Traveling Engineers' Association, composed of men supervising the work of steam locomotive engineers, there was an attractive exhibit of apparatus, although few of the exhibits were of electrical interest. The Pyle National Electric Headlight Company, of Chicago, and the Moon Manufacturing Company, of Chicago, exhibited electric headlights. The H. W. Johns-Manville Company and the Dearborn Drug & Chemical Works made exhibits of apparatus familiar to electrical men.

Additions to Iowa Power Station.—The Des Moines City Railway Company is building an extension to its power station in Des Moines, and has recently purchased equipment as follows: One 300-kw rotary converter from the Westinghouse Electric & Manufacturing Company and one 500-kw rotary converter, together with three 750-kw transformers, from the General Electric Company. No contracts have been awarded for new switchboards. Bids have been invited on a traveling crane and coal-handling apparatus for the station.

Electrical Construction.—Among the items printed under Construction News in the present issue are announcements of proposed new plants or considerable extensions to present plants at Morrillton, Ark.; Pasadena, Cal.; High Springs, Fla.; Shelbyville, Ind.; La Cynge, Kan.; Battle Creek, Mich.; Portland, Ore.; Scranton, Pa.; Maryville, Tenn.; Trenton, Tenn.; Denton, Tex.; Sinton, Tex.; Colonial Beach, Va.; Fond du Lac, Wis., and Scott, Sask., Can.

Additions to Louisville Lighting Plant.—The General Electric Company has completed the installation of a 10,000-hp turbo-generator, in the plant of the Louisville Lighting Company. A new condenser was also installed at the same time. Water is secured through several artesian wells sunk by the company, and is stored in a reservoir, in which it is cooled by artificial means. G. Wilbur Hubley is chief engineer of the company.

Foreclosure Sale of California Traction at San Francisco.—On Oct. 30 the property of the San Francisco, Vallejo & Napa Valley Railway will be sold under foreclosure. The sale is a result of an action brought against the company by the Mercantile Trust Company, of San Francisco, for default of bond interest in June, 1911.

Foreign Trade Opportunity.—Under Schedule 7264, on file at the Bureau of Manufactures, Washington, D. C., an American consular officer in the Far East reports the incorporation of a hydroelectric company in his district, with a capital of $10,000,000. The company will furnish about 80,000 hp in the locality.

Many Switchboard Orders.—During the month of August over 800 panel boards were turned out at the East Pittburgh shops of the Westinghouse Electric & Manufacturing Company. This is slightly in excess of the output in July, when the total was 751 panels.

Chicago & Milwaukee Electric Railway Company.—Samuel Insull, chairman of the Chicago Elevated Railways, has denied the rumor that the consolidated companies are to purchase the Chicago & Milwaukee Electric Railway Company.

Aluminum Notes and Prices.—Quotations as of Sept. 5 give ingots for resmelting at 20 cents to 22 cents spot No. 1, the base for large ingots; and 31 cents for rods and wire. Sheets are held at 33 cents. The market is reported steady.

Financial.

THE WEEK IN WALL STREET.

BUSINESS in the latter part of the past week was of course influenced by the holidays, but, in spite of the quietness, the prices and transactions on Friday were regarded as decidedly encouraging for beginning the month of September. Many fractional advances were made, and at the close the list was in a much stronger position than in the greater part of August. This cheerful feeling was in evidence on Tuesday and, although opening prices were low, a rally was made early in the day and the higher prices maintained to the close. The early weakness was caused in a large measure by the conditions on foreign exchanges. Declines in Canadian Pacific in Berlin, resulting from agitation over the Moroccan trouble, were reflected in London by a drop of 4 points, and by a loss of 3 points at the opening in Wall Street. Other railroad issues held in Berlin were weak here in the early transactions but recovered their losses and nearly all made small advances over Friday's prices. While the volume of trading was not large, it was in excess of that on Friday, and prices were marked by absence of the selling pressure that was evident in the trading of the past two weeks. Features of the transactions on Tuesday were gains in American Tobacco shares and initial trading in Standard Oil certificates on the new basis. While no plan of readjustment of the former company has been presented to the committees representing security holders, the day's transactions served as an indication of progress in rearranging the affairs of the company. Public interest in the market continues to be very light, although there is a fair degree of outside participation in the bond market. While the labor agitation on the Harriman lines is not a leading factor in the market, the financial district is watching developments with interest. The roads at this time are in a strong position to meet the demands of the unions, and an amicable settlement is expected. Withdrawals of currency for meeting harvest requirements in the South and West have increased and propects of reductions of surplus reserve of Clearing House banks have caused a slight hardening of rates for time money. Rates Sept. 5 were: Call, 2¼ @ 2⅜ per cent; ninety days, 3¼ @ 3½ per cent. The quotations in the tables are those at the close Sept. 5.

NEW YORK.

	Aug. 29.	Sept. 5.	Shares sold.		Aug. 29.	Sept. 5.	Shares sold.
All. Ch.....	6½*	6½*	———	Int. Met., pf.	43½	44⅝	2,700
All. Ch. pf..	18*	18	200	Mackay Cos..	83½*	83⅛	100
Amal. Cop....	58	59¼	51,010	Mackay C.,pf.	72*	72	100
Am. D. T...	20½*	20½*	———	Man. Elev...	135	135*	1,500
Am. Loco....	34⅞	35⅝	2,200	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	104¾*	105¾	125	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	79¾*	80½*	50	Steel, com...	69¾	71¼	499,643
Am. T. & T..	131⅞	135	15,155	Steel, pfd....	114¼	115¾	9,300
B. R. T.....	75¼	76½	3,500	W. U. T.....	74	75	850
Gen. Elec....	151¾	150¼	1,850	West'h, com..	64¼*	65½	1,100
Int. Met.....	14½	15⅜	3,400	West'h, pf.d.	114*	114*	———

PHILADELPHIA.

	Aug. 29.	Sept. 5.		Aug. 29.	Sept. 5.
Am. Rys.....	44½	44½	Phila. R. T.....	22¾	22⅝
El. Co. of A.....	11¾*	11¾	Phila. Elec.....	17⅛	16⅞
Elec. St. Bt'y.....	52¼	53	Phila. Trac.....	84½	85
Elec. St. Bt'y., pf...	30*	30*	Union Trac.....	50½	50⅝

CHICAGO.

	Aug. 29.	Sept. 5.		Aug. 29.	Sept. 5.
Chi. City Ry.....186*		186*	Com. Edison.....132⅜		133½
Chi. Elev. Rys.....	25*	25*	Chi. Subways.....	2¾*	2¾*
Chi. Elev. Rys., pf..	90*	90*	Chi. Tel. Co.....120½		120½
Chi. Rs., Ser. 1.....	95*	95*	Nat'l Car.....100*		100*
Chi. Rs., Ser. 2....	27¼	29⅞	Nat'l Car, pf.....118½*		118½*

BOSTON.

	Aug. 29.	Sept. 5.		Aug. 29.	Sept. 5.
Am. T. & T.....131⅞		135¼	Mex. Tel.....	4¼*	4¼*
Cum. Tel.....156*		156*	Mex. Tel. pf.....	6*	6*
Edison Ill.....286		284½	N. E. Tel.....145		145
Gen. Elec.....151		151	W. T. & T.....	18¼*	16
Mass. E. Ry., pf....	88*	86½	W. T. & T., pf.....	98*	98
Mass. E. Ry.....	17¼	18			

*Last price quoted.
Shares sold for the week, Aug. 28 to Sept. 1.

FINANCIAL NOTES.

Pacific Power & Light Company.—A limited amount of the 7 per cent cumulative preferred stock of the Pacific Power & Light Company is being offered by New York banking houses. The stock is preferred as to dividends and assets, and is redeemable at 115 and accrued dividend. The company was incorporated in June, 1910, under the laws of the State of Maine, and is a consolidation of various established properties serving thirty-five communities and the surrounding country in the States of Washington, Oregon and Idaho. The company now owns electric power plants having a capacity of approximately 20,735 hp, of which 13,300 hp is hydroelectric. In addition to these, there is now under construction additional hydroelectric capacity of 1,350 hp. There are now in operation over 300 miles of high-voltage transmission lines, and 175 miles of line are under construction. The company owns street railways in Astoria, Oregon and Walla Walla, Washington, and water works in North Yakima. In addition to these properties the company also owns and operates a number of gas plants in the locality. Its gross earnings for the twelve months ending July 30, 1911, were $1,155,526; net earnings were $553,423; bonds and other interest was $254,771, and the surplus for dividends was $298,652. Deducting from this preferred stock dividends amounting to $65,625 there was left a surplus of $233,027. The expenditures of the company for new construction and for the acquisition of additional properties between July 1, 1910, and May 31, 1911, have aggregated $1,800,938. The majority of the franchises of the company are unlimited as to time, and the others are for long terms. All are free from objectionable restrictions. J. G. White & Company estimated that the physical property of the company, as of Nov. 1, 1910, after deducting depreciation, had a value of $4,510,103 cash, no allowance being made for water rights or for intangibles, such as going business, good will or franchises. The Pacific Power & Light Company is under the management of the American Power & Light Company, which owns the entire outstanding common stock of the company. The American Power & Light Company is controlled by interests associated with the Electric Bond & Share Company, which in turn is controlled through stock ownership by the General Electric Company.

American Light & Traction Company.—As has been the case with the majority of public utility companies, the American Light & Traction Company has shown improvement during the dullness in general business and judging from the returns in the seven months of the current year, the company will earn more on its stock than in any previous year. Gross income in this period was $2,395,203 as compared with $2,050,754 in 1910, and net earnings were $2,229,620, as compared with $1,982,408. The company earned 27.65 per cent on its common stock in 1910, and if the present rate is maintained, as is probable in view of the approach of the winter season, over 28 per cent will be earned on the $10,339,300 outstanding common stock. This is entitled to 10 per cent after 6 per cent has been paid on the $14,236,200 preferred stock. There has been a steady increase in dividend disbursements since 1902. dividends at that time amounting to $499,947, as compared with $2,849,296 in 1910. In the past seven months, the operating ratio was 28.57 per cent, which compares with 31.23 in 1910.

New Orleans Railway & Light Company.—Gross earnings of the New Orleans Railway & Light Company increased about $231,000 in the seven months ended July 31, and the surplus over charges was 5.33 per cent on the $10,000,000 outstanding preferred stock, as compared with 4.61 per cent in the corresponding period in 1910. It is expected that the American Cities Company, which was recently formed to take over the properties of the New Orleans Railway & Light Company and the American Cities Railway & Light Company, will earn about 3¾ per cent on its outstanding common stock during the twelve months ended June 30, 1912.

Public Service Corporation of New Jersey.—Notice has been given by the Public Service Corporation of New Jersey that the 5 per cent, five-year collateral gold notes issued by the corporation under date of Oct. 1, 1910, amounting to $4,000,000, and secured by a trust agreement between the corporation and the Fidelity Trust Company, of Philadelphia, as trustee, will be redeemed and paid with accrued interest at the office of the Trust Company in Philadelphia on Oct. 2, 1911. After this date interest will cease to accrue.

Crocker-Wheeler Company.—The balance sheet of the Crocker-Wheeler Company, as of July 30, 1911, as given in a circular issued by the company's fiscal agents, states as follows: Assets: Plant, $1,338,678; patents, $25,000; stocks and bonds, $32,788; merchandise, $751,333; accounts receivable, $565,978; cash, $120,165, making a total of $2,833,943. Liabilities are given as follows: Common stock, $1,700,000; preferred stock, $500,000; bills payable, $215,000; accounts payable, $19,517; surplus, $399,426.

Virginia Railway & Power Company.—In the fiscal year ended June 30 the statement of the Virginia Railway & Power Company, including that of the Norfolk & Portsmouth Traction Company, shows that a surplus available for dividends of 8.37 per cent was earned on the $7,689,900 outstanding preferred stock, as compared with 5.89 per cent in the previous year, indicating that the consolidation of the two companies has been as beneficial as was expected. The gross earnings of the two companies were $4,335,206, an increase of $356,758 over the same item in 1910. Operating expenses were $2,340,676, and the net revenue was $1,994,530. Other income was $46,296, making a total income of $2,040,826, which is an increase of $162,436 over the corresponding item of the previous year. Interest, taxes and other charges were $1,396,943. The surplus for the year was $643,883, an increase of $191,029. The individual incomes of the two companies were but little different from the showing in the previous year. The individual income of the Virginia Railway & Power Company was about $2,250,000, while that of the Norfolk & Portsmouth Traction Company was about $2,000,000.

Burke Electric Company.—The statement of the Burke Electric Company, of Erie, Pa., for the fiscal period ended April 29 shows net profits available for dividends of 8.03 per cent on the $1,250,000 outstanding capital stock. The balance sheet as of April 29 showed as follows:—Assets: Cash, $12,479; investments, $3,878; accounts receivable, $114,248; inventory, $434,128; patents, good will, etc., $901,454, making a total of $1,466,087. Liabilities were given as follows: Preferred stock, $250,000; common stock, $1,000,000; notes and accounts payable, $31,682; previous surplus $103,982; surplus for 1911, $80,423. The dividends paid during this fiscal period were $20,000, which left a balance of $80,423 to be carried to profit and loss surplus. Under inventory were included $154,630 for material and merchandise; $99,818 for real estate, buildings and fire-protection system, and for merchandise, equipment, tools, etc., $179,680.

American Telephone & Telegraph Company.—As stated in these columns July 1, payment of subscriptions to the $50,000,000 capital stock of the American Telephone & Telegraph Company issued at that time may be made in full or in four equal instalments payable Nov. 1, 1911; Feb. 1, May 1 and Aug. 1, 1912. To subscribers who have purchased the rights and wish a negotiable instrument between September and Nov. 1 the company will issue a temporary receipt upon either full or part payment. No interest will be paid upon this receipt. This may be used for convenience of the purchaser until full paid or partly paid stock is issued by the company on Nov. 1. The right to subscribe to the new issue expired last week.

Susquehanna Transmission Company.—The Susqeh nna Transmission Company has been authorized by the Maryland Public Service Comission to issue $1,031,000 5 per cent bonds at 90, for meeting its obligations to the Pennsylvania Water & Power Company. The issue was approved by the commission in June, but the order was withheld pending guarantee by the Pennsylvania Water & Power Company of principal and interest, this being authorized by the directors of the company on August 24. A mortgage and deed of trust securing the bonds will be filed with the Knickerbocker Trust Company, of New York.

Chicago Telephone Company.—It is expected that the Chicago Telephone Company will shortly issue an additional $5,000,000 first-mortagage 5 per cent bonds for financing new construction work in the city and the districts in which it operates. The new issue will be the first financing on the part of the company since the sale of the present $5,000,000 outstanding bonds in 1909. The remainder of the $50,000,000 bonds authorized may be issued, in accordance with the terms of the mortgage, at a rate of not more than $5,000,000 per year, but not to exceed 50 per cent of the total assets of the company.

Buffalo General Electric Company.—The report of the Buffalo General Electric Company for the six months ended June 30, 1911, shows that operating revenue in this period amounted to $597,405, an increase of $74,653 as compared with this period in the previous year. Expenses and taxes were $358,680, an increase of $47,253, and net earnings were $238,728, showing a gain of $27,401. Other income was $25,602, making a total of $264,327, as compared with $233,257 in the corresponding period last year. Interest charges were $73,606, and the surplus for the period was $190,721, comparing with the $166,494 shown in the first six months of 1910.

Sherbrooke Railway & Power Company.—The stockholders of the Sherbrooke Railway & Power Company have authorized an issue of $300,000 additional consolidated first-mortgage 5 per cent bonds, in connection with the recent purchase of the Eastern Townships Electric Company, the Lenox Light & Power Company and the Haustead Electric Company, and for extending the distribution systems of these companies. A banking house has been authorized to offer $150,000 of the bonds at 95 and interest, carrying a bonus of 40 per cent common stock.

Oklahoma Utility Merger.—A plan for consolidating a number of traction interests in Oklahoma City is under consideration. If the merger is effected the Oklahoma Railway Company, which controls practically all of the street-railway systems in Oklahoma City, will absorb the Oklahoma Central Railroad Company, which now operates between Chickasha and Colgate, with a view of transforming a portion of this line into an electric interurban system. The plan includes connecting the Oklahoma Street Railway lines with those of the Oklahoma Central Company.

Mississippi River Power Company.—Right of way for a transmission line from Keokuk, Ia., to Florissant, Mo., has been secured by the Mississippi River Power Company. The company is having surveys made for extending the line from Florissant to St. Louis, where it plans to supply energy in 1913 through the Mississippi River Distributing Company, which was formed for this purpose. Most of the distribution system in St. Louis will be underground.

Commonwealth Edison Company.—There is an unofficial statement to the effect that the Commonwealth Edison Company will arrange such financing as is needed this fall through the sale of between $4,000,000 and $5,000,000 new stock at par, instead of selling additional issues of first-mortgage 5 per cent bonds.

Long Acre Electric Light & Power Company.—The Long Acre Electric Light & Power Company has executed a general mortgage of $50,000,000 to the Empire Trust Company, of New York, with a deed of trust covering all of its properties in Manhattan and the Bronx. The mortgage is to run for fifty years and will bear interest at 5 per cent.

Boston Traction Merger.—The stockholders of the West End Street Railway Company, at a meeting this week, voted to accept the terms of consolidation of the Boston Elevated Railway Company, and 221,770 shares of the 301,119 represented at the meeting voted in favor of this plan.

DIVIDENDS.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent. payable Oct. 1.

Butte Electric & Power Company, quarterly, 1¾ per cent, payable Oct. 2.

Consolidated Gas, Electric Light & Power Company, of Baltimore, semi-annual, preferred, 3 per cent; quarterly, common, 1¼ per cent; both payable Oct. 2.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable Oct. 2.

Twin City Rapid Transit Company, quarterly, preferred, 1¾ per cent; common, 1½ per cent; both payable Oct. 2.

REPORTS OF EARNINGS.

BANGOR RAILWAY & ELECTRIC COMPANY.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
July,	1911.....	$55,677	$26,809	$28,868	$13,056	$15,812
"	1910.....	54,007	24,775	29,232	11,921	17,311

CHATTANOOGA RAILWAY & LIGHT COMPANY.

July,	1911.....	$84,175	$50,362	$33,813	$19,870	$13,943
"	1910.....	88,412	46,501	41,911	18,601	23,310

PORTLAND (ORE.) RAILWAY, LIGHT & POWER COMPANY.

July,	1911.....	$543,704	$258,938	$284,766	$130,660	$154,106
"	1910.....	490,724	237,378	253,346	116,507	136,839

ST. JOSEPH (MO.) RAILWAY, LIGHT, HEAT & POWER COMPANY.

July,	1911.....	$92,375	$60,202	$32,173	$19,239	$12,934
"	1910.....	90,928	51,289	39,639	18,274	21.365

UNION RAILWAY, GAS & ELECTRIC COMPANY.

July,	1911.....	$244,931	$141,736	$103,195	$62,924	$40,271
"	1910.....	232,318	134,084	98,234	59,480	38,754

General News

Construction News.

DOTHAN, ALA.—Bonds to the amount of $70,000 have been voted, the proceeds to be used for the construction of an electric-light plant.

GLOBE, ARIZ.—The Miami Copper Company is planning to increase the output of its power plant. New machinery will be installed.

MORRILLTON, ARK.—The Morrillton Light & Power Company is making preparations to install new machinery in its plant. The company, it is understood, is planning to establish a twenty-four-hour service. G. H. Burr is vice-president.

BAKERSFIELD, CAL.—Bids are being asked by the Guaranty Pipe Line Company for the erection of a telephone system between Midway field and Ventura, a distance of 70 miles. The cost of the work is estimated at about $15,000.

COLTON, CAL.—Electricity for operating the substation now being erected by the Southern California Edison Company in Colton will be transmitted from the Long Beach power plant on high-tension transmission lines. Private right-of-way has been secured for the entire distance. The Edison company has commenced work on the erection of a new transmission line from the mouth of Santa Ana Canyon to Highland, a distance of 6 miles. The substation at Colton will supply electricity for Colton, Riverside, San Bernardino, Redlands, Highland and other points in this end of the valley.

FRESNO, CAL.—The San Joaquin Light & Power Company has decided to reconstruct its private telephone system between Fresno and Bakersfield at a cost of about $18,000. The company has begun work on the construction of a new substation in Fresno and the erection of a new transmission system from the Madera County transmission line to Dos Palos, Los Banos and Gustine, a distance of about 80 miles.

GLENDALE, CAL.—It is reported that preparations are being made by the Glendale & Eagle Rock Railway Company to extend its electric railway from Glendale into the country, which ultimately will reach Sunland, 13 miles distant. Other improvements will also be made to the system.

HAMILTON, CAL.—Plans are being made by the Sacramento Valley Colony Company to install new pumping machinery and motor equipment. Sloan & Robinson, of San Francisco, Cal., are engineers.

KELSEYVILLE, CAL.—Application has been made to the County Supervisors by James A. Gunn, Jr., for a fifty-year franchise to erect and operate electric transmission lines on the public roads in Kelseyville and Lake County.

LONG BEACH, CAL.—The City Club has authorized C. E. Jarvis, president of the club, to appoint a committee to confer with the City Council of Los Angeles relative to the construction of an electric railway, 4 miles in length, to connect Long Beach municipal docks and railway with the Los Angeles municipal railway.

LOS ANGELES, CAL.—The residents of the Laurel Canyon district are planning to establish a lighting district and install a tungsten lamp street-lighting system.

LOS ANGELES, CAL.—The Otis Elevator Company has secured the contract for installing four traction electric passenger elevators, one electric passenger elevator and one hydro-air sidewalk elevator in a thirteen-story building being erected by the Los Angeles Investment Company at Eighth Street and Broadway, at $37,000.

LOS ANGELES, CAL.—The Southern Pacific Company has decided to discard the oil burner lamps now in use and to equip its engines with the electric headlights. Electricity for operating the lamps will be generated by a small dynamo attached to an axle of the engine. The cost of the change is estimated at about $200,000.

LOS ANGELES, CAL—Specifications have been completed for the electrical equipment of the San Francisquito No. 1 power site, located about 47 miles north of Los Angeles. This station will have a generating capacity of about 30,000 hp. The cost of the machinery is estimated at about $350,000, bids for which will be received until Oct. 20. E. F. Scattergood is chief engineer of the department.

MODESTO, CAL.—The Sierra & San Francisco Power Company is planning to make extensive improvements to its distributing system and other branches, including the erection of a new substation, work on which has been started.

NEVADA CITY, CAL.—The Northern Water & Power Company is reported to have acquired property on Shady Creek as a site for a large reservoir and hydroelectric plant. Other storage dams and power plants will be erected at French Corral and other points on San Juan ridge.

OROVILLE, CAL.—Arrangements are being made by the Great Western Power Company and the T. B. Walker and Curtis, Collins and Holbrook timber interests for the construction of a railroad from a point on the Western Pacific Railroad to the Big Meadows. The proposed railroad will be about 18 miles in length and will extend along the north fork of the Feather River at the junction of north fork and the east branch. The plans also include the construction of a large saw mill. The cost of the entire work is estimated at about $1,750,000.

PASADENA, CAL.—The city clerk has been authorized to advertise for bids for the installation of an ornamental street-lighting system on South Orange Grove Avenue, the cost of which is estimated at $50,000.

RIVERSIDE, CAL.—The contract for installation of an ornamental street-lighting system on Twelfth Street, between Main and Pepper Streets, has been awarded to the Southwestern Electrical Company for $2,395.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has submitted a bid to the Board of Supervisors for lighting the suburbs of Oak Park, Highland Park, Curtis Oaks and East Sacramento, offering to supply arc lamps at $6 each per month; under the old contract the charge was $6.30 each per month. The South Sacramento Power Comapny submitted a bid asking $6.20 per lamp per month for the service.

SAN BERNARDINO, CAL.—The Southern Sierras Power Company has been granted a franchise to erect and operate an electric transmission line in San Bernardino for a period of fifty years. Under the terms of the franchise the company is to pay the city 5 per cent of its gross earnings after the first five years. The company paid $150 for the franchise.

SAN FRANCISCO, CAL.—Surveys have been completed by the United Properties Company for its proposed railway between Oakland and Sacramento.

SAN JOSE, CAL.—Plans are being considered for installing an electric-light system on Market Street. It is proposed to erect luminous arc lamps. The service will be supplied by the Great Western Power Company.

SAN JOSE, CAL.—Preparations are being made by the Great Western Power Company to extend its system to San Jose. The company expects to reach this city by Jan. 1, 1912, with its long-distance transmission lines and will probably erect a steam plant here without delay to furnish electricity for lamps and motors until the lines are completed. The transmission line to Livermore will be completed about Sept. 15. The present plans of the company involve an expenditure of about $250,000.

SANTA ANA, CAL.—The Southern California Edison Company has submitted an offer to the City of Santa Anna offering to sell its local distributing system, exclusive of transmission lines and other property, for $165,000, on condition that the city enter into a fifteen-year contract with the company to purchase energy at the rate of 2 cents per kw-hour.

SANTA MONICA, CAL.—The city has entered into a contract with the Southern California Edison Company for street lighting, under the terms of which the company is to supply arc lamps at the rate of $5 per lamp per month, on a moonlight schedule. If lamps are operated all night the rate is to be increased 75 cents per lamp per month. About 134 lamps will be used.

SUSANVILLE, CAL.—Water locations have been filed on Eagle Lake and Willow Creek by Alva Udell for hydroelectric development.

BOULDER, COL.—The City Council is considering the question of establishing a municipal electric-light plant in Boulder.

DURANGO, COL.—The San Juan Water & Power Company is reported to be contemplating extending its service to Creede. It is proposed to erect a transmission line from the Tacoma plant to supply the city of Creede with electricity for lamps and motors and also the mines and mills in that vicinity.

JOHNSTOWN, COL.—The Johnstown Milling & Elevator Company is making arrangements to equip its machinery for electrical operation, energy for which will be supplied by the Northern Colorado Power Company. The company has purchased a 50-hp motor to replace the gasoline engine now in use.

PYRAMID, COL.—The Chuckawalla Development Company is making preparation to construct a large dam at Bull's Head Canyon, below Pyramid, on the Colorado River. A power plant will be installed to supply electricity to operate the pumps to supply water to irrigate a large tract of land in the Chuckawalla valley.

NEW HAVEN, CONN.—Plans have been completed by the United Illuminating Company to erect an ornamental lighting system on Chapel and Church Streets in the business district. It is proposed to erect eighty lamp standards, each carrying a group of five lamps. The expense for extra lighting is to be borne by the merchants and business houses in that section.

SOUTH NORWALK, CONN.—The Housatonic Power Company is planning to extend its service to Georgetown as soon as improvements to the power plant and power and lighting systems in the Norwalks are completed.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has awarded contract for the erection of the addition to its

power plant on Buena Vista Street to A. S. Reed & Brother Company, of Wilmington, Del. The cost of the plant complete is estimated at $60,000. The company is rebuilding its distributing line extending along Vandever Avenue and across Eleventh Street bridge, the cost of which is estimated at about $10,000. Preparations are being made by the Wilmington & Philadelphia Traction Company to install ornamental lamps on Market Street, to cost about $15,000. It is expected to have the system ready in October.

HIGH SPRINGS, FLA.—The local ice company is contemplating the installation of an electric-light plant in connection with its ice factory. The company will soon apply for a franchise to supply electricity for lamps on Main and First Streets.

NEW SMYRNA, FLA.—The installation of an electric-light plant, water works and sewer system is under consideration. A. D. P. Smith is chairman of committee.

BOISE CITY, IDAHO.—It is reported that W. S. Kuhn, of Pittsburgh, Pa., and associates are contemplating the construction of a chain of large hydroelectric plants along the Snake and Salmon Rivers, where it is estimated that from 125,000 to 200,000 hp can be developed. The Snake River from Milner to Payette has been selected as the site for several power plants.

CANTON, ILL.—The Illinois Central Electric Railway Company has awarded the contract for the construction of its extension from Norris to Farmington to the Porter Construction Company, of Mackinaw.

COLUMBIA CITY, IND.—The Farmers' Mutual Telephone Company is rebuilding its telephone system and is placing its wires in underground conduits.

DUGGER, IND.—The Sullivan County Electric Company has applied to the Town Board for a franchise to install and operate an electric-light plant in Dugger.

EVANSVILLE, IND.—The Evansville, Henderson & Owensboro Railway Company, recently incorporated to construct and operate an electric railway between Evansville, Henderson and Owensboro, is planning to erect and operate an electric transmission line to supply electricity for lamps and motors in the cities named. The company also proposes to operate a ferry to transport interurban cars across the Ohio River. The directors are: W. A. Carson, W. H. McHurd, M. S. Sontagg, Philip Speck, C. H. Battin and C. C. Tennis.

GARY, IND.—Work will be started at once on the construction of the Gary, Hobart & Eastern Traction line, which is to connect Gary and Hobart. Citizens of Hobart and farmers residing along the line are financing the railway.

INDIANAPOLIS, IND.—The Postal Telegraph Company will place its wires underground in the business district of the city in compliance with an order of the Board of Public Works. The contract for building the underground conduit has been awarded to Gest & Company, of Cincinnati, Ohio.

KENDALLVILLE, IND.—F. H. Fradick, of Toledo, Ohio, consulting engineer in connection with remodeling and improvements to the municipal electric-light plant and water works system, has recommended the construction of spurs from the railroads entering the city to the power house, the cost of which is estimated at about $20,000. He also recommends the installation of a three-phase electric system and the installation of gas and oil engines for motive power. The cost of the entire work is estimated at about $60,000.

LOGANSPORT, IND.—The contract for building the concrete power dam on the Eel River at Tenth Street has been awarded to J. Yawger & Company, at $10,985. The dam will replace the present wooden structure.

NEW CASTLE, IND.—Preparations are being made by the Indianapolis, New Castle & Toledo Railway Company for making a survey of its proposed extension from New Castle to Richmond, via Millville, Hagerstown and Greensfork. It is expected that work will begin on this extension this year.

NOBLESVILLE, IND.—The plant and holdings of the White River Light & Power Company, of Noblesville, Ind., which was sold at receivers' sale recently, have been acquired by the Noblesville Heat, Light & Power Company and the Indianapolis Water Company for $30,000. It is understood that the transmission lines and such part of the steam plant as can be used will be taken over by the Noblesville Heat, Light & Power Company. The dam, located on the White River 2 miles north of this city, will not be completed at present. The Indianapolis Water Company, it is understood, hopes eventually to secure part of its supply from the reservoir at the dam.

OAKLAND CITY, IND.—Plans are being considered for the installation of a central heating plant to supply all the buildings on the campus of the Oakland City College.

RUSHVILLE, IND.—The Rushville Furniture Company is building a new factory which will be equipped for electrical operation.. The company will install an electric generating plant and will soon be in the market for machinery and equipment for same.

SHELBYVILLE, IND.—The City Council has appropriated $8,000 for the purchase of new machinery and equipment for the city pumping station.

SOUTH BEND, IND.—It is understood that work will soon be resumed by the South Bend & Logansport Traction Company on its railway from South Bend to Logansport, at which point connection will be made with the Indiana Union Traction Company for Indianapolis.

VINCENNES, IND.—Contracts have been awarded by the Vincennes North & South Traction Company for the construction of its proposed railway from Vincennes to Sullivan. B. M. Willoughby, of Vincennes, Ind., is president.

VINCENNES, IND.—Arrangements are being made by the Vincennes & Southeastern Interurban Railway Company to secure the right of way for its proposed electric railway from St. Meinrad to Troy, and from Troy through Tell City to Cannelton. Right of way from Vincennes to St. Meinrad has already been obtained.

WORTHINGTON, IND.—The Indiana Water & Light Company has sold its plant and holdings to W. H. Yule, of Hartford City, Ind. It is understood that the new owner will take charge of the plant at once.

CHARLES CITY, IA.—The Western Electric Telephone Company, it is reported, is contemplating extensions and improvements to its system involving an expenditure of about $40,000. F. M. Win, of Des Moines, is engineer.

CLARION, IA.—The Jenson Construction Company has secured the contract for rebuilding the local electric-light plant, owned by Mozingo & Mack, which was recently destroyed by fire. The cost of the work is estimated at about $4,500.

COLFAX, IA.—The Colfax Electric Light Company has been granted a franchise to erect a transmission line from its Colfax plant to Prairie City to furnish electricity for lamps and motors in that city.

COON RAPIDS, IA.—The installation of a three-lamp electrolier lighting system in Coon Rapids is under consideration. The local electric-light company agrees to supply electricity for operating the lamps at the same rate the town is now paying for arc lamps.

KEOKUK, IA.—The Mississippi River Power Company has secured all the right of way for the transmission line from its plant at Keokuk, Ia., to Florissant, Mo., and surveys are now being made for the route from Florissant into St. Louis, Mo. The selection of a site for a transforming station in St. Louis is now under consideration. It is expected to furnish electricity in St. Louis in 1913. The Mississippi River Distributing Company has been formed to distribute the energy in St. Louis. Most of the cables and wires in St. Louis will be placed underground.

OGDEN, IA.—The City Council has decided to enter into a contract with the Boone Electric Company, of Boone, Ia., to supply electricity to operate the municipal electric-light system. In order to meet demands for electrical service it would have been necessary to make extensive repairs to the municipal plant and it seemed more feasible to purchase energy from Boone, giving the city a twenty-four service, than to rehabilitate the plant.

LA CYGNE, KAN.—Plans have been prepared by the J. S. Worley Company, Reliance Building, Kansas City, Mo., for the construction of an electric-light plant and water-works system in La Cygne, bids for which, it is said, will be called for in the near future. The cost of the work is estimated at about $30,000.

MANHATTAN, KAN.—The Manhattan City & Interurban Railway Company will soon be in the market for material for its proposed electric railway from Manhattan to Fort Riley, including rails, ties, poles, machinery, overhead material, etc. The railway will be about 15 miles in length. Joseph T. West, of Manhattan, Kan., is general manager.

FRANKFORT, KY.—The State Board of Control is considering the question of building an electric railway from the Western Kentucky Asylum for the Insane to Hopkinsville, a distance of about 2 miles. The cost of the proposed railway, including equipment, is estimated at about $35,000.

LOUISVILLE, KY.—The installation of a 10,000-hp turbo-generator set in the power plant of the Louisville Lighting Company has been completed by the General Electric Company. A new condenser was also installed at the same time. G. Wilbur Hubley is chief engineer.

WATERVILLE, MAINE.—Bids have been submitted to City Council for street lighting by the Waterville & Fairfield Railway & Light Company and the Central Maine Power Company for a period of five years. The Waterville & Fairfield Railway & Light Company offers to furnish electricity to light the city with the present equipment at $5,560 per year, and for additional service will charge $10 for each additional arc lamp and $5 for each incandescent lamp, equipment to be furnished by the city, and $5 each for additional fire alarm boxes and police signal boxes, material to be furnished by the city. The Central Maine Power Company agrees to supply the service at $5,740 per year and to supply additional arc lamps at $50 each, 32-cp incandescent lamps at $6 each per year, and for additional fire alarm and police signal bells, $4.50 each per year. The Central Maine Power Company also agrees to present to the city a check for $6,000 to be used in the construction of the proposed central fire station upon signing of the contract. The company has been furnishing the service for the past five years at $5,300 per year.

BALDENSBURG, MD.—The Washington, Westminster & Gettysburg Railway Company, it is reported, has purchased a mill building, which it proposes to remodel for electric power house. W. H. Saunders, 1407 F Street, Washington, D. C., is president of the company.

HAGERSTOWN, MD.—Announcement has been made that the residents of Washington County have subscribed to $90,000 of bonds of the Hagerstown & Clearspring Electric Railway Company and that the construction of the railway is assured. The company will apply to the Public Service Commission for permission to begin work on same at once.

BROOKLINE, MASS.—The Board of Selectmen has granted the Edison Electric Illuminating Company, of Boston, permission to extend to its underground conduit system in Brookline.

CHARLTON, MASS.—The Selectmen have granted the Southbridge Gas & Electric Company a franchise to erect transmission lines through the town. The company has a contract to furnish electricity to the Masonic Home and will supply electrical service along its line.

MELROSE, MASS.—Mayor Eugene H. Moore has signed a contract with the Malden Electric Company for lighting the streets of the city for a period of ten years. The new contract calls for an all-night moonlight schedule. Under the old contract the lamps burned until 12.30. The appropriation for this year is $15,680 for street lighting.

NORTH ADAMS, MASS.—It is reported that the power plant to be erected on the Deerfield River by the New England Power Company will supply electricity to operate trains through the Hoosac tunnel and the Berkshire Street Railway Company's system. It is understood that the power plant in Zylonite will be used as an auxiliary plant. The New England Power Company is planning to build a storage reservoir at Searsburg, Vt., in the upper waters of the Deerfield.

BATTLE CREEK, MICH.—Plans are being considered by the Commonwealth Power Company for the erection of a large power plant in Battle Creek, to be located on Union Street near the Battle Creek River. It is proposed to make Battle Creek the distributing center of the hydroelectric development on the Au Sable River for this district when completed. The dam now being built, which will develop about 9000 hp, will be one of thirteen to be erected on the river.

CANBY, MINN.—The Citizens' Electric Light & Power Company, it is reported, is contemplating the installation of an electric-light plant in Canby, to cost about $25,000.

GILBERT, MINN.—The installation of a municipal electric-light plant in Gilbert is reported to be under consideration.

JANESVILLE, MINN.—Plans are being prepared by the Consumers' Power Company, of Mankato, Minn., to extend its system from that place to Janesville to furnish electrical service in the town. The company also proposes to extend its transmission lines to Eagle Lake and Waseca.

NORTH BRANCH, MINN.—It is reported that the Eastern Minnesota Power Company is contemplating the installation of an electric lighting system in North Branch during the coming Fall.

KANSAS CITY, MO.—Plans are being considered by John Rowe, of Shawnee; George Casebeer, A. L. Howard, of Louisburg, and associates to construct and operate an electric railway between Kansas City and Fort Scott.

MONETT, MO.—The contract for equipment and machinery for the proposed municipal electric-light plant has been awarded to the Squire Electric & Construction Company, of Kansas City, Mo., for $28,000, and for construction of power house to H. T. Bramer, of Monett, Mo., for $3,197. Rollins & Wesotver, of Kansas City, Mo., are consulting engineers.

SPRINGFIELD, MO.—The Green County Court has granted the Ozark Power & Water Company permission to build and maintain conduits and pipe through the highways of Greene County for the transmission of power from its proposed light plant near Hollister, Mo. The company proposes to furnish electricity to all cities and towns between its plant and Springfield.

ST. JOSEPH, MO.—The City Council is reported to be considering the question of issuing bonds for improvements to the municipal electric-light plant so as to supply electricity for commercial purposes as well as for street lighting. A special election will probably be called to submit the proposition to the voters.

ST. JOSEPH, MO—The contract for electrical work on the new Burlington Swift-Armour bridge, which is being erected on the old Winner piers, has been awarded to the American Electrical Company, of which Luther E. Reid, of St. Joseph, Mo., is president. The contract calls for an expenditure of more than $25,000.

WARRENSBURG, MO.—It is reported that plans are being considered for the installation of an electric-light plant at the State Normal School in Warrensburg, to cost about $20,000.

SIDNEY, MONT.—The Sidney Electric & Fuel Company has been granted a franchise to install and operate an electric-light plant in Sidney.

TERRY, MONT.—The installation of an electric-light plant in Terry is reported to be under consideration. Edward Phillips is said to be interested in the project.

BURWELL, NEB.—It is reported that Messrs. Reasoner and Beardsley, of Lincoln, Neb., who are planning to build a dam on the Loup River, north of Burwell, have secured subscriptions amounting to $10,000 toward the project. The plans include the development of 1000 hp and supplying electricity to light towns and the construction of an electric railway to Taylor and Almeria.

GORDON, NEB.—The Johnston Electric Company, of Omaha, Neb., is reported to have secured the contract for installation of an electric-light system in Gordon. H. D. Huntington is city clerk.

CARSON CITY, NEV.—The construction of an electric railway from Carson City to Lake Tahoe is reported to be under consideration. D. Williams, one of the owners of the Glenbrook golf links on Lake Tahoe, is interested in the project.

WESTFIELD, N. J.—The construction of an electric railway between Westfield and Newark, via Irvington, Germantown, and along Echo Lake, is reported to be under consideration by L. P. Naylor and associates.

BALLSTON SPA, N. Y.—The properties and franchises of the Hudson River Electric Power Company, including subsidiary companies and the large generating plant at Spier Falls, were sold Aug. 29 at foreclosure sale to Frank M. Edwards, of Boston, Mass., representing the bondholders' committee, for $7,500,000.

EPHRATAH, N. Y.—The Mohawk Hydro-Electric Company is reported to have purchased the Yauney Woolen Mill and about twelve acres of land for $13,300. The company, it is said, will equip the mill and operate it, providing the electric railway goes through the town.

PINE BUSH, N. Y.—At an election held recently the citizens voted to authorize the Commissioners to enter into a contract with the Wallkill Valley Light & Power Company, of Walden, N. Y., to light the streets of the village for a term of five years.

ROCHESTER, N. Y.—The Rochester Railway & Light Company is planning to increase the output of its power station No. 6 by 2000 hp.

LENOIR, N. C.—It is reported that negotiations are under way between the Board of Trade and H. L. Millner, reported to represent Baltimore capitalists, relative to building a hydroelectric plant on Catawba River. It is proposed to furnish electricity in Lenoir to the amount of 2000 hp.

RALEIGH, N. C.—It is reported that the Southern Power Company, of Charlotte, N. C., is contemplating making a connection with the lines of the Carolina Power & Light Company, of Raleigh. The transmission lines of the Southern Power have been extended as far as Durham and it is proposed to extend the line to Raleigh. It is understood it is proposed to connect up the two systems so as to place the companies in a position to connect their lines in case of emergency. The Carolina Power & Light Company is erecting a substation near Raleigh and is also making surveys for the erection of transmission lines to Henderson and Oxford and to Goldsboro and the East.

SHELBY, N. C.—The City Council, it is reported, is contemplating purchasing the electric plant of the Shelby Light & Power Company or building a new plant. The company offers the plant to the city for $20,000.

BISMARCK, N. D.—The contract for the installation of ornamental lamp standards in the business district of the city has been awarded to Grambs & Peet, of Bismarck, N. D., at $12,157.

BELLEFONTAINE, OHIO.—Plans are being considered by the Belle Center Commercial Club and Eastern capitalists for the construction of an electric railway, 60 miles in length, to connect Findlay, Russell's Point, Lewiston, Reservoir, Kenton, Belle Center, Huntsville and the reservoir resorts of Lakeridge and Orchard Island.

COLUMBUS, OHIO.—It is reported that bids received by H. S. Holton, Director of Public Service, on Aug. 22, for ornamental cast-iron lamp standards to be used in connection with the installation of cluster lamps in the city, have been rejected. It is understood that new bids will be called for.

TOLEDO, OHIO.—The Toledo Factory Company, recently organized by the factories committee of the Commerce Club, proposes to erect an industrial power plant building, which was projected by the old Chamber of Commerce. The company is capitalized at $300,000. Isaac Kinsey is chairman.

WARREN, OHIO.—The Mahoning & Shenango Railway & Light Company is planning to build a belt line railway in Warren, Ohio.

WOODSDALE, OHIO.—The Miami Power Company, of Hamilton, recently incorporated, is reported to be contemplating the construction of a hydroelectric power plant on the site of the Catfield & Woods paper mill. Electricity generated at the plant will be transmitted to Hamilton, Middletown, Miamisburg and Franklin. The cost of the plant is estimated at about $500,000. Post office address is Trenton, Ohio.

FALLS CITY, ORE.—The Van Zandt & James Company is contemplating the construction of a hydroelectric plant in the Willamette Valley.

MARSHFIELD, ORE.—Surveys are being made by the Coos Bay & Eastern Electric Railway Company for its proposed railway from Marshfield to Roseburg, via, Myrtle Point.

PORTLAND, ORE.—The Valley Improvement Company will soon begin work on construction of its hydroelectric plant near Randle, Wash. The cost of the plant and transmission system is estimated at $15,000,000.

HARRISBURG, PA.—The Central Pennsylvania Traction Company has placed orders with the Hooven-Owens & Rentschler Company, of Hamilton, Ohio, for a cross-compound, condensing engine to be connected to General Electric 1600-kw, 500-volt, direct-current generator to be installed in its Harrisburg plant.

HAZLETON, PA.—The erection of another large electric power plant in the Hazleton region is under consideration. Surveys are being made at Hazle Creek, 7 miles east of Hazleton, along the Lehigh Valley Railroad, with a view of locating a power plant at the point where the streams meet others flowing from the Hazleton district. Edmund Coxe, of Philadelphia, Pa., is said to be interested in the project.

PHILADELPHIA, PA.—Permits have been granted to the Philadelphia Rapid Transit Company for the erection of a concrete and brick substation on East Ledderly Street, to cost about $23,000, and a storage

building on East Cumberland Street, to cost $7,000. H. B. Nichols, 820 Dauphin Street, Philadelphia, Pa., is chief engineer.

PHILADELPHIA, PA.—The Pennsylvania Equipment Company, West End Trust Building, Philadelphia, Pa., is reported to be in the market for a second-hand 300-400-kw, 250-volt, direct-current generator direct connected to engine; also a second-hand 300-kw, 250-volt, direct-current generator with steam turbine, steam pressure 150 lb., 26 to 28 in. vacuum.

PHILADELPHIA, PA.—The Luzerne County Gas & Electric Company, recently incorporated with a capital stock of $2,090,000, has taken over the following companies recently incorporated in Luzerne County: The West Wyoming, Warrior Run, Union Township, Hunlock Township, Sugar Notch, Shickshinny, Larksville, Pringle Township, Wyoming Lake Township, Lehman Township, Forty Fort and Jackson Township electric companies and the Gas Company of the West Side. The office of the company will be located in Philadelphia. M. W. Stroud is president of the company.

PHILADELPHIA, PA.—The Philadelphia Suburban Gas & Electric Company, recently chartered with a capital stock of $4,542,500, has taken over the following companies recently incorporated, all located in the vicinity of Philadelphia: The Gas Company of Delaware County, the Gas Company of Rock Ledge, the Gas Illuminating Company of Delaware County, the Horham, Southampton, Upper Dublin, Whitpain, Warminster and Township Electric companies; Warwick Suburban Electric Company, of Upper Pottsgrove, West Pottsgrove, Lower Pottsgrove, Upper Providence, East Pikeland, Limerick, East Vincent and East Coventry. The office of the company will be located in Philadelphia. M. W. Stroud is president.

PITTSBURGH, PA.—The City Council is making investigations at the municipal electric-light plant on the North Side with a view of making improvements to same. An appropriation of $18,000 was made by the old city of Allegheny but was not used. New machinery is needed at the power house, and the Council is considering the advisability of enlarging the plant.

PHOENIXVILLE, PA.—The construction of an electric railway from St. Peters to Phoenixville is reported to be under consideration. David J. Knauer and associates are said to be interested in the project.

SCRANTON, PA.—The United Service Company, which operates the Tuscarawas County Electric Light & Power, which supplies electrical service in New Philadelphia and Canal Dover, Ohio; the New Philadelphia Heating Company; United Electric Company, of Dennison, Ohio, which supplies electricity in Dennison, and operates the Uhrichsville Street Railway, which connects Dennison and Uhrichsville, is planning extensive improvements and extensions to its Ohio plant, involving an expenditure of several hundred thousand dollars and including the erection of new power houses, reconstruction of transmission lines and other improvements. The company recently took over the property of the Warren Light & Power Company, of Warren, Pa. L. H. Conklin is manager of the company. The main office of the company is located in Scranton, Pa.

SOMERSET, PA.—It is reported that all bids for the construction of the power house for the new water-works plant have been rejected.

WAYNESBORO, PA.—Rights of way are being secured by the Chambersburg, Greencastle & Waynesboro Street Railway Company for the construction of an extension of its railway from Chambersburg to Shippensburg.

YORK HAVEN, PA.—E. F. Baker was dismissed as receiver of the York Haven Water & Power Company on Aug. 26 by Judge Wanner. The plant will be operated under the direction of Mr. Baker, who was general superintendent of the York Haven plant prior to the receivership. The receivership has been in force since Feb. 24, 1910.

STA. YSABEL, P. R.—Plans have been prepared by Blas C. Silva, civil engineer, of Ponce, P. R., for installing an electric-light plant with sufficient output to supply electricity for incandescent lamps for about 400 families and for street lighting. The equipment is to include a gasoline engine, generator, switchboard, lamps and accessories.

JAMESTOWN, R. I.—The erection of an electric-light plant in Jamestown is reported to be under consideration.

PROVIDENCE, R. I.—William D. Marks, of New York, N. Y., has been engaged by the City Council committee on lights to investigate the street-lighting system in Providence. Investigation will also be made of both the electric and gas commercial lighting systems.

CHARLESTON, S. C.—Bids will be received at the office of Ione Simons, city electrician, until Oct. 18 for lighting the streets of the city of Charleston, S. C., for a term of one, two or four years with electricity, gas or some other illuminating power equivalent thereto. The estimate requirements are 300 arc lamps, of the inclosed type, of 1200 cp. Specifications will be furnished on application. The service is to be furnished by June 30, 1912.

PIERRE, S. D.—The Twentieth Century Transportation Company, recently incorporated, proposes to construct an electric railway from Chicago to Rapid City to cross Illinois, northeast Iowa, Minnesota and South Dakota by the way of Decorah, Minneapolis, Watertown and Pierre. The company is capitalized at $1,000,000. The headquarters of the company are located in Pierre.

KNOXVILLE, TENN.—The City Council has granted the Eastern Tennessee Power Company a franchise to supply electricity in Knoxville for a period of thirty-five years, under the terms of which the company is to pay the city of Knoxville 1 per cent of its gross receipts for the first fifteen years, 2 per cent for the second fifteen years, and 3 per cent for the remaining five years. The company also agrees to supply electricity to all consumers for lamps and motors at 10 per cent less than is now paid for the service and to supply arc lamps for street lighting at $60 each per year. The city now pays $72.50 per lamp per year.

MARYVILLE, TENN.—The Maryville Electric Light, Heat & Power Company, recently incorporated, is planning to erect a large hydro-electric plant at Abram's Falls on Abram's Creek, 25 miles from Maryville. It is proposed to supply electricity for lamps and motors in this place and other towns and cities in the county. The incorporators are: I. B. Zeigler, John M. Clark and James A. Goddard, of Maryville, and J. G. and William Sterchi, of Knoxville, Tenn.

TRENTON, TENN.—The City Council has passed an ordinance authorizing a bond issue to the amount of $12,000, the proceeds to be used for the installation of a municipal electric-light plant. An election will be held Sept. 28 to submit the proposition to a vote.

WINCHESTER, TENN.—Plans are being considered by the Light and Water Department for the erection of a new pumping station. A two-stage, 250-gal. turbine pump will be installed. The station will be located about three-fourths of a mile from the town. William J. Dodge is superintendent of the Light and Water Department.

DENTON, TEX.—Plans are being considered for improvements to the municipal electric-light plant, including the installation of a new generator.

FT. WORTH, TEX.—The Ft. Worth Power & Light Company has filed for record a mortgage and deed of trust in favor of the Citizens' Savings & Trust Company, of Cleveland, Ohio, to secure a bond issue of $10,000,000.

GALVESTON, TEX.—It is reported that financial arrangements have been made for the construction of a large dam across the Devil River in Western Texas, for the purpose of irrigating a large cotton field consisting of 156,000 acres in McKinney, Valverde and Maverick counties. The plan also includes the erection of a large cotton mill to be operated by electricity generated by water power created by the dam. The cost of the work is estimated at about $5,000,000.

SINTON, TEX.—The plant and holdings of the Sinton Ice & Power Company have been purchased by R. V. Covey, of Houston, Tex., and J. K. Ross, of Oklahoma City. The company will be known as the Sinton Ice, Light & Power Company. It is proposed to enlarge the electric plant and supply electricity for the entire town. A new generator will be installed.

OGDEN, UTAH.—The Ogden Rapid Transit Company is contemplating the construction of an extension from Brigham City to Grace, Utah.

OGDEN, UTAH.—The Merchants' Light & Power Company has completed the erection of its electric system, including 275 arc lamps for street lighting, and is now negotiating with the City Council to have the street-lighting contract start from Sept. 1 instead of Sept. 27 as originally planned. The contract with the Utah Light & Railway Company expired several months ago and the city is at liberty to turn the contract over to the new company at any time. Under the new contract the city will save $250 per month on the cost of street lighting and will also secure a number of lamps for the city buildings and parks free of cost.

SALT LAKE CITY, UTAH.—The City Council has granted the Utah Light & Railway Company a franchise to extend its railway system to Capital and University Heights districts. The Utah Light & Railway Company is contemplating raising its dam at the east end of the Ogden canyon.

RUTLAND, VT.—The Rutland Light & Power Company has secured an injunction against the Clarendon Power Company, recently incorporated to build a power plant at the Clarendon gorge on Mill River, which has undertaken to condemn forty acres of land along the Mill River with water power, which is now owned by the Rutland Company.

ARLINGTON, VA.—Arrangements are being made by the Arlington Electric Company to extend its system from Columbia pike to Clarendon, a distance of 2½ miles. The line will eventually be extended to Falls Church. Electricity for operating the system will be supplied by the Alexandria County Electric Light Company.

COLONIAL BEACH, VA.—Bids will be received until Oct. 11 by H. W. B. Williams, Mayor, for the construction of a power house. Harry Stevens, Union Trust Building, Washington, D. C., is consulting engineer.

WEST POINT, VA.—The Town Council has granted the People's Light, Heat & Power Company an exclusive franchise for a period of thirty years.

ABERDEEN, WASH.—It is reported that the installation of a municipal electric-light plant in Aberdeen is under consideration.

CHEHALIS, WASH.—Application has been made to the County Commissioners by A. W. Van Arsdell for a franchise to erect transmission lines in Lewis County to supply electricity for lamps and motors.

CHEHALIS, WASH.—The Chehalis & Cowlitz Railroad Company, which was organized to build a railway between Chehalis and a point on the Cowlitz River, has entered into an agreement with the Washington-Oregon Corporation, of Chehalis, Wash., to build and operate its railway in Chehalis and east and south for 1½ miles. The last-named company will operate the railway temporarily.

LYLE, WASH.—The Northwestern Electric Company has purchased 12 miles of water rights on the Klickitat River, near here, from Ham, Yearsley & Ryrie, of Spokane, for $75,000. Plans are being made for the erection of additional power plants in this section. The company is now building a large power plant near here. Herbert Fleischhacker, of San Francisco, Cal., is interested in the company.

NEWPORT, WASH.—The Interstate Telephone Company has applied for a franchise to erect its system in Newport, Wash. J. W. Fisher is manager.

OLYMPIA, WASH.—The Olympia Light & Power Company is reported to have awarded the contract for construction of the Lake Lawrence reservoir on the Des Chutes River to A. A. Borey & Company, of Tacoma, to cost $18,000.

SEATTLE, WASH.—George W. Dilling, Mayor, has authorized the City Council to sell $800,000 of municipal street-car bonds, which were authorized by the voters last March, to provide funds for the acquirement by purchase or condemnation proceedings or for the construction of a new railway through the Ranier Valley, paralleling the line of the Seattle, Renton & Southern Railway, between Fyan Street, at the southern city limits and Stewart and Blanchard Streets on the north. The ordinance also provides for an extension from Stewart and Blanchard Streets and Third Avenue to Salmon Bay at Thorndyke Avenue, a distance of 4 miles. City Engineer R. H. Thompson has completed the valuation of the property of the Seattle, Renton & Southern Railway and an offer of $386,063 was made for the railway by the Board of Public Works. E. D. O'Brien, assistant superintendent of public utilities, estimates that the property of the company can be duplicated at a cost not to exceed $550,000, leaving $250,000 for the extensions to Ballard and for betterments.

SPOKANE, WASH.—The Home Automatic Telephone Company is making arrangements to build a telephone station on Fourth and Napa Streets. J. B. Langely is manager.

SPOKANE, WASH.—The Interstate Telephone Company is planning to build a new exchange building on Trent Avenue. Connection will be made with the system of the Home Automatic Telephone Company, thereby rendering service over the entire district.

TENINO, WASH.—The Washington-Oregon Corporation has acquired the property of the Tenino Light, Power & Water Company, of Tenino. The consideration is said to be $40,000.

TOPPENISH, WASH.—The Town Council is reported to have granted the Reservation Electric Company a franchise to install and operate an electric-light and power plant in Toppenish for a period of fifty years.

WARWOOD, W. VA.—The Warwood Power & Light Company, recently organized, will soon apply to the Council for a franchise to construct and operate an electric-light plant in Warwood. William Emsley, W. E. Helfenfine, R. A. Alexander, Edward Kilver and Earl Bell are interested in the company.

FOND DU LAC, WIS.—Plans are being considered by the Eastern Wisconsin Railway & Light Company for an addition to its power house on North Main Street and Rees Street in Fond du Lac, to cost about $12,000.

RED DEER, ALTA., CAN.—The Board of Trade has engaged the Galt Engineering Company, of Calgary, to make preliminary surveys for the construction of a hydroelectric plant. R. T. Davidson is secretary of Board of Trade.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company is planning to build an extension from New Westminster to Millside.

VICTORIA, B. C., CAN.—The City Council is contemplating extending the ornamental street-lighting system on View Street. It is understood that provision will be made for installing conduits for wires for arc lamps in the James Bay district.

HAMILTON, ONT., CAN.—The Board of Control has recommended to the City Council the erection of a transmission line through the city for the purpose of utilizing power from the hydroelectric power system, under the bylaw passed July 25. It is proposed to erect a temporary line through the city from the end of the present line to supply the Gore, the City Hospital and various other municipal buildings and several other institutions of the city. It is also proposed to sell power to consumers along the route to defray the expenses of construction of the line.

LONDON, ONT., CAN.—Petitions are being circulated in the city asking the residents to petition the City Council to extend the ornamental street-lighting system. The petition asks for 325 lamp standards, each carrying five lamps, making a total of 1625 lamps.

NORTH TORONTO, ONT., CAN.—The Town Council has entered into a contract with the Hydroelectric Power Commission to supply electricity to operate the municipal electric-light system for a term of five years. The Toronto Electric Light Company submitted a bid offering to maintain and operate the plant and supply street lamps at $14 each per year and to furnish electricity to private consumers at city rates, and in addition to pay the town 5 per cent per annum on the cost of the plant as rental. The tender submitted by the Interurban Electric Company, Ltd., offered to operate the plant and furnish street lamps at $9 each per year and supply electricity for lamps at 3 cents per kw-hour.

PRINCE ALBERT, SASK., CAN.—At an election held Aug. 27 the by-law authorizing an appropriation of $700,000 for the construction of a hydroelectric power plant at La Colle Falls was carried.

SCOTT, SASK., CAN.—Tenders will be received by G. M. Phillips, secretary and treasurer, until Sept, 25 for furnishing and delivering the following machinery and supplies: Tender A—Generator, exciter, switchboard, transformers, meters, series tungsten street-lighting system and pumping system. Tender B—Two pneumatic storage tanks. Tender C—Approximately 2200 ft. of 3-in. steel wire pipe; 7000 ft. of 6-in. water pipe; 5400 ft. of 4-in. steel water pipe and approximately 15 hydrants and 24 valves. Tender D—Trenching and laying steel water pipe, setting hydrants, valves, etc., and back filling. Tender E—Erection of power house and reservoir. Plans and specifications may be seen at the office of MacArthur & Murphy, engineers, Bottomly Block, Saskatoon, Can.

New Industrial Companies.

THE AUTO LIGHTING & ELECTRIC COMPANY, of Indianapolis, Ind., has been incorporated by G. S. Montfort, C. R. Brown and F. C. Parker. The company proposes to manufacture electrical lamps for vehicles. A plant will be established in Indianapolis, Ind.

THE BAIRD ELECTRIC SCORE BOARD COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000. The directors are: George E. Baird, president; Roscoe F. Potts, 163 Hemenway Street, Boston, Mass., treasurer, and Stuart N. Lake.

THE CARTHAGE ELECTRIC COMPANY, of Carthage, Ill., has been granted a charter with a capital stock of $500 to do a general electrical manufacturing business. The incorporators are: William Mathiesen, Victor W. Olff and H. C. Hall.

THE COPEMAN ELECTRIC STOVE COMPANY, of Flint, Mich., has been organized with a capital stock of $500,000 to manufacture a patent electric heater. Samuel H. Abbott is interested in the company.

THE ELECTRIC MOTOR CAR COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $10,000 by Noble H. Davis, Arthur E. Keller and A. B. Davis.

THE FLEXIBLE CONDUIT COMPANY, of Guelph, Ont., Can., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing and dealing in textile materials, conduits, cables and other electrical supplies. The directors are : George Edmund Coutrice, of Clinton, Ont.; James Ernest Carter and John McPherson Taylor, of Guelph.

THE GRANGER ELECTRIC & MANUFACTURING COMPANY, of Warren, Ind., has filed articles of incorporation with a capital stock of $50,000 to manufacture household electrical devices, including toasters, irons, etc. The directors are: Francis Granger, R. L. Tobin and Frank Canady.

THE GREENSBORO CONSTRUCTION COMPANY, of Greensboro, N. C., has been organized by John J. Dunnigan, J. A. Armfield and J. M. Hunt. The company proposes to construct electric plant and waterworks systems, etc.

THE MARQUETTE COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $10,000 to manufacture motors, engines, machines, etc. The incorporators are: B. S. Mantz, H. A. Black and John R. Turner, all of Jersey City, N. J.

THE SERVICE ELECTRIC COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $5,000 for the purpose of manufacturing electrical machinery. The incorporators are: Gerald G. Barry, Andrew W. Little and Lee Cohn.

THE THOMPSON ENGINE STARTER COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $500,000 to manufacture machinery, etc. The incorporators are: W. M. Kingsley, G. F. Scott and F. I. Eldridge, of New York, N. Y.

THE WICKER ELECTRIC LINOTYPE POT COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000. The incorporators are: F. Hendrick, J. S. Lewis, of New York, and H. M. Wicker, of Brooklyn, N. Y.

THE WOODHOUSE ELECTRIC COMPANY, of Norfolk, Va., has filed articles of incorporation with a capital stock of $50,000 for the purpose of dealing in electrical supplies and doing a general electrical business. The officers are: Jonathan Woodhouse, president; John S. Woodhouse, vice-president, and H. C. Woodhouse, secretary and treasurer, all of Norfolk, Va.

New Incorporations.

PHOENIX, ARIZ.—The Salt River Valley Electric Railway Company has been incorporated with a capital stock of $600,000 for the purpose of building an electric railway 60 miles in length to connect Phoenix and Peoria and intervening towns. The officers of the company are: F. M. Winters, president; Jacob Kleck, vice-president; C. C. Lewis, secretary, and J. M. Swetman, treasurer.

BAKERSFIELD, CAL.—The Bakersfield Gas & Electric Light Company has been incorporated with a fully-paid capital of $100,000 by H. A. Jastro, H. A. Blodget and L. C. McAfee. Head offices will be established at Los Angeles.

WAKARUSA, IND.—Articles of incorporation have been filed for the Home Electric Company with a capital stock of $15,000 by James E. Gall, Jacob E. Bollingbacher and Victor H. Schalliol. The company proposes to supply electricity for light, heat and motors in Wakarusa.

HAZARD, KY.—The Hazard Light & Water Company has been incorporated with a capital stock of $25,000 by Jesse Morgan, J. B. Hoge and T. S. Ward.

PORTLAND, MAINE.—The New England Power Company of Maine has filed articles of incorporation with a capital stock of $5,000,0000. The incorporators are: C. E. Eaton, T. L. Croteau, Albert F. Jones, A. A. Richards and B. M. Maxwell, of Portland, Maine.

BOSTON, MASS.—The New England Water Power Company has filed articles of incorporation under the laws of the State of Massachusetts with a capital stock of $1,500,000. The incorporators are: Robert H. Bresnahaw, Norman J. MacGaffin and Harold W. Cairns. The company is contemplating a hydroelectric development on the Deerfield River.

LACLEDE, MO.—Articles of incorporation have been filed for the Laclede Electric Light Company with a capital stock of $5,000 by Z. T. Stanley, E. B. Alten, R. L. Wheeler and others.

LEWISTON, N. Y.—The Lewiston & Lake Ontario Shore Power Company has been incorporated with a capital stock of $25,000. The incorporators are: A. Mackey, of Youngstown; C. H. Tugwell, of Wilson, N. Y.; J. B. Scovell, of Lewiston, N. Y., and H. M. Clark, of Niagara Falls, N. Y. The company proposes to supply electricity for lamps and motors in the village of Lewiston and the towns of Wilson, Porter and Newfane. A franchise has already been granted the company in Lewiston.

OKLAHOMA CITY, OKLA.—A charter has been granted to the Oklahoma City & Eastern Railroad Company to build a railway to be operated by steam or electricity, from Oklahoma City and Henryetta, a distance of 90 miles. The company is capitalized at $3,000,000. The directors are: J. J. Johnson, Charles Hoppes, W. J. House, F. S. Combes and M. L. Spitler.

HOOD RIVER, ORE.—The Hood River Terminal Company, of Portland, has been incorporated by W. A. Delashmutt, A. B. Ireland and W. Chapman. The company is capitalized at $5,000 and proposes to construct either a steam, gasoline or electric railway from a point on the Oregon-Washington Railroad & Navigation Company line in Hood River to the steamboat landing, ½ mile east of the city.

DOUGLASSVILLE, PA.—The Manatawny Railroad Company has been incorporated by Milton J. Person, of Bethlehem, Pa., president; John Palmer, Jr., of Jersey City, N. J.; Stephen Robinson, Jr., of Audubon, N. J.; Lewis F. Huthmacher, of Bethlehem, Pa.; Charles M. Allen, of Bayonne, N. J.; Daniel J. Driscoll, of Reading, Pa., and Robert L. Runyon, of Allentown, Pa. The company is capitalized at $100,000 and proposes to build an electric railway between Douglassville and Spangville, a distance of 8 miles.

FREEPORT, PA.—The Freeport Electric Power Company has been granted a charter with a capital stock of $5,000 to supply electricity in Freeport. The incorporators are: F. W. Diven, Jr., of Ingram, Pa.; W. B. Wallis, of Crafton, Pa., and W. R. Hamer, of Pittsburgh, Pa.

GETTYSBURG, PA.—The Conewago Township Electric Light, Heat & Power Company has been granted a charter with a capital stock of $5,000. The company proposes to supply electricity for lamps and motors in several places in Conewago Township, principal among which are Edgegrove and Mount Rock. The incorporators are: Raymond F. Topper, George J. Benner and Stella I. Raffensberger. Ellis S. Lewis, of York, Pa., is treasurer. The main office of the company is located at Gettysburg, Pa.

HARRISBURG, PA.—Charters have been granted by the State Department to the following companies: East Donegal Township Electric Light Company; the East Hempfield Township Electric Company; the East Lampeter Township Electric Company; the Lancaster Township Electric Company; the Manhein Township Electric Company; the Manor Township Electric Company; the Mount Joy Township Electric Company; the Mountville Electric Light Company; the Penn Township Electric Light Company; the Rapho Township Electric Light Company; the Warwick Township Electric Company; the West Lampeter Township Electric Company; the West Donegal Township Electric Light Company, and the West Hempfield Township Electric Company. Each company is capitalized at $5,000 and the directors are: John S. Graybill, Jr., of Lancaster, Pa., treasurer; W. W. Griest, C. Edgar Titzell, all of Lancaster, Pa. The companies will do business in the districts indicated by the names they bear. The headquarters of all the companies will be located in Lancaster.

LEBANON, PA.—The Lebanon & Campbelltown Street Railway Company has been granted a charter with a capital stock of $60,000 to build an electric railway, 10 miles in length, to connect Lebanon and Campbelltown, via South Londonderry, South Annville and North Comwall. M. S. Hershey is president.

McSHERRYSTOWN, PA.—A charter has been granted to the McSherrystown Electric Light, Heat & Power Company with a capital stock of $5,000. The company proposes to supply electricity for lamps and motors in McSherrystown, for which a franchise has already been applied for. The incorporators are: Raymond F. Topper, George J. Benner and Stella I. Raffensberger. Ellis S. Lewis, of York, Pa., is treasurer. The main office of the company is located at Gettysburg, Pa.

MOOSIC, PA.—The Moosic Electric Company has been incorporated with a capital stock of $5,000. The directors are: Duncan T. Campbell, of Scranton, Pa., treasurer; J. G. Osterhout, and Max F. Henkelman, all of Scranton, Pa.

NEW OXFORD, PA.—The New Oxford Electric Light, Heat & Power Company has been chartered with a capital stock of $5,000 by Raymond F. Topper, George J. Brenner and Stella I. Raffensberger, for the purpose of supplying electricity for lamps and motors in New Oxford. The company has applied for a charter to operate in this town. The main office of the company is located at Gettysburg, Pa. Ellis S. Lewis of York, Pa., is treasurer.

PITTSTON, PA.—The Piedmont Electric Company has been granted a charter with a capital stock of $5,000. The directors are: J. A. McMillan, of West Pittston, treasurer; W. S. Tompkins, and Lewis Jones, all of West Pittston, Pa.

PLYMOUTH, PA.—A charter has been granted to the Consumers' Light Company with a capital stock of $5,000. The directors are: Thomas J. Conelly, of Wilkes-Barre, Pa., treasurer; John F. McGroaty, of Edwardsville, Pa., and Charles M. Powman, of Wilkes-Barre, Pa.

SCRANTON, PA.—The Taylor Electric Company has been granted a charter with a capital stock of $5,000. The directors are: Duncan T. Campbell, of Scranton, Pa., treasurer; J. G. Osterhout and Max F. Kenkelman, all of Scranton, Pa.

SOUTH BETHLEHEM, PA.—The South Bethlehem Light, Heat & Fuel Company has been incorporated with a capital stock of $5,000. The directors are: Henry T. Duke, 510 North Thirty-ninth Street, Philadelphia, Pa., treasurer; C. Jess Young, of Philadelphia, Pa., and Elmer S. Myers, of Wilmington, Del.

SOUTH BETHLEHEM, PA.—The Moravia Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are: H. M. Ueberroth, of South Bethlehem, Pa., treasurer; A. C. Graham, P. F. Enright, James M. Degnan, C. A. Buck and Charles H. Green, all of South Bethlehem, Pa.

SOUTH BETHLEHEM, PA.—Articles of incorporation have been filed for the Fountain Hill Electric Light, Heat & Power Company. The company is capitalized at $5,000 and the directors are: H. M. Ueberroth, of South Bethlehem, Pa., treasurer; A. C. Graham, P. F. Enright, James M. Degnan, C. A. Buck and Charles H. Green, all of South Bethlehem, Pa.

SPRINGFIELD, S. C.—Articles of incorporation have been filed for the Springfield Light & Power Company with a capital stock of $20,000. The company proposes to build a plant on Dean Swamp Creek, 2½ miles out of the city. About 100 hp will be developed. John B. McB. Deane is president of the company; Michael Chattin, vice-president, and J. B. Smith, secretary and treasurer.

SOUTH PITTSBURG, TENN.—The South Pittsburg Light Company has been granted a charter with a capital stock of $10,000. The incorporators are: W. C. Houston, A. L. Kelly, Charles Houston, J. A. Price and J. B. Phillips.

AUSTIN, TEX.—The South Austin Street Railway Company has been granted a charter with a capital stock of $25,000, to operate an electric railway in South Austin. The directors are: J. H. Green, F. H. Faust, T. M. West and C. V. Birkhead, of San Antonio, Tex., and E. B. Birkhead, of Dallas, Tex.

SPOKANE, WASH.—Articles of incorporation have been filed for the International Power Manufacturing Company by W. S. Yearsley and Martin H. Gerry, Jr. The company proposes to construct a dam across the Spokane River at the site of the new paper mill at Millwood.

CASCADE, W. VA.—The Preston County Development Company has been incorporated with a capital stock of $100,000, by Everhart Bierer, of Morgantown, W. Va.; C. C. Clear and A. W. Hawley, of Masontown, W. Va.; Roy Clear and D. B. Davis, of Cascade, W. Va. It is understood that the company proposes to develop the water power of the Cheat River on the Big Sandy River along the banks of the river owned by the Preston County Coke Company, to generate electricity for transmission to Masontown, Kingwood and Morgantown.

CHILLIWACK, B. C., CAN.— The Chilliwack Tramway Company has been incorporated to build an electric railway within the municipal limits of Chilliwack.

Personal.

MR. W. W. REESE, formerly of the Corn Products Refining Company, has recently taken charge of the power plant economy department of the W. H. Zimmerman Company, engineers and constructors, Chicago.

MR. W. GODFREY BOYD has been retained as consulting engineer by the Haskins Glass Company, Wheeling, W. Va., which he will advise in the development of a full line of indirect and semi-indirect lighting units.

MR. D. C. BARNES, superintendent of the Pawtucket, (R. I.) Electric Company, has been appointed manager of the Everett Railway, Light & Water Company and the Seattle-Everett Traction Company, Everett, Wash.

MR. WILLIAM MARCONI is spending the present week at St. Johns, N. F., conducting experiments with the object of ascertaining the advisability of installing a more powerful station on the spot where his first wireless telegraph tests were made.

MR. W. R. MADDOX has been appointed superintendent of the new municipal central station of Terre Haute, Ind. Mr. Maddox had been with the Terre Haute, Indianapolis & Eastern Traction Company since his graduation from Rose Polytechnic Institute in 1909.

MR. FRANK H. McCORMICK has resigned as private secretary of General Manager J. E. Davidson of the Pacific Power & Light Company, Portland, Ore., to take up the duties of local manager of the Pacific Power & Light Company's property at Pomeroy, Wash. Mr. P. N. Berens, who has resigned at Pomeroy, will take up new duties in the power production department.

MR. F. H. FRADICK, of Toledo, recently engaged by the City Council as consulting engineer in the remodeling and improving of the city water-works and electric-lighting systems, has recommended the construction of spurs from the railroads entering the city to the power house, the installation of a three-phase electric system and the substitution of steam for gas and oil engines for motive power.

MR. S. W. CHENEY, a member of the engineering staff of the Railroad Commission of Wisconsin, has been appointed inspector in charge of the Milwaukee district. This district was recently established by the commission and includes all the public utilities within the city of Milwaukee and immediate suburbs. Mr. Cheney is a graduate of the University of Wisconsin and has for several years been engaged in gas and electric central-station work.

MR. T. C. MARTIN, secretary of the National Electric Light Association, goes to the Pacific Coast the coming week to make preliminary arrangements at Seattle for the convention of 1912. He will also attend the convention at Spokane of the Northwest Electric Association, which is proposing to affiliate, and while on his trip will address the company sections at Vancouver and Milwaukee, returning in time for the convention of the New England section in the White Mountains at the end of the month.

MR. E. C. NOE, who has been general manager of the Northwestern Elevated Railroad Company, of Chicago, and general superintendent of the Chicago & Oak Park Elevated Railroad Company, has been made general manager of the Metropolitan West Side Elevated Railway Company and the South Side Elevated Railroad Company also, his authority covering all of the elevated railways of Chicago, now combined under the ownership and control of the Chicago Elevated Railways. Mr. Noe was for several years connected with the old Thomson-Houston Electric Company and the General Electric Company in Chicago.

Trade Publications.

COMPOUND CORLISS ENGINES.—Bulletin No. 1512 issued by the Allis-Chalmers Company, Milwaukee, Wis., describes the company's various types of compound Corliss engines for all classes of service. The engines are built in sizes up to 10,000 hp and over.

MOTOR-GENERATOR SETS.—An attractive publication recently isued by the General Electric Company on the subject of motor-generator sets (Bulletin No. 4849) contains brief descriptions of generator sets of different styles and sizes. These sets are made up of various combinations of alternating and direct-current generators and motors, and range in capacity from 95 kw to over 7000 kw.

ILLUMINATING GLASSWARE.—A 100-page catalog issued by the Fostoria Glass Specialty Company entitled "Illuminating Glassware" lists and illustrates by means of half-tone cuts more than 1500 different styles of clear, cut and etched globes, shades and reflectors for electric and gas lamps, being, in fact, a reference work on the numerous schools of design exemplified in modern decorated illuminating glassware. The book itself is most attractively put together, and in spite of its scope is not at all unwieldy.

CONVENIENT DECIMAL EQUIVALENTS.—The Electrical Manufacturers' Equipment Company, of 310 South Desplaines Street, Chicago, issues a little vest-pocket reference book containing a conveniently arranged table for finding the decimal equivalents of halves, quarters, eighths, sixteenths, thirty-seconds and sixty-fourths of an inch, as well as the decimal equivalents of drams, ounces and pounds. The table, which is copyrighted by Mr. F. B. Segur, also contains a brief account of the Segur hairpin-loop armature coil winding machine, designed for the use of manufacturers of generators and motors.

LOCOMOTIVE CRANES.—The Browning Engineering Company, Cleveland, Ohio, has issued an attractive illustrated booklet on its locomotive cranes. By this is meant a traveling crane operating usually, but not always, upon a railroad track and having the function of hauling and rotating in a full circle, traveling along the track or roadway, hauling cars or trucks and varying the boom or jib radius. This makes the crane applicable to almost every line of industry for handling heavy or bulky materials. A few of the more important details of construction are illustrated and described briefly, as well as some of the many uses for which the cranes and various attachments are adapted.

ELECTRIC LOCOMOTIVES FOR SWITCHING AND LIGHT FREIGHT SERVCE.—Bulletin No. 4867, issued by the General Electric Company, describes and illustrates electric locomotives for switching and light freight service, varying in weight from 22 to 35 tons, according to the service requirements and type of electrical equipment employed. The electrical equipment of these locomotives is of medium capacity, arranged for slow speeds, and it is essential that the design be as simple as possible and that all parts should be readily accessible. In general, the equipment comprises four 50-hp motors and Sprague-General Electric Type M control. Where two locomotives are operated together multiple-unit couplings are supplied.

AUTOMATIC STOKER FURNACES.—The Model Stoker Company, Dayton, Ohio, has issued a bulletin describing its automatic smokeless furnace, including not only grates and suitable fronts, but also double coal magazines, one on each side, stoking and cleaning mechanism and an engine with connections for operating all the working parts. The grates are arranged in pairs and inclined from the sides to the central bearer, one of each pair on each side being stationary and the other movable. The latter are hinged to the stationary grates by a pin lug, which fits into a hole at the upper end of the grate, the lower end of the movable grate being held to place and rocked by a bar. The furnace can be adapted to any of the regular types of boilers, and handles and burns soft coal.

HYDROELECTRIC AND IRRIGATION PLANT.—The Priest Rapids development of the American Light & Power Company, Hanford, Wash., is a good example of a highly economical and efficient method of utilizing low-head water-power which is subject to extreme variations in head resulting from flood conditions. It is also an example of modern engineering practice in irrigation work where the head is insufficient or the topography makes it impossible to deliver water to the surrounding country by gravity. The station is designed for an ultimate development of 9800 hp from a minimum head of 18 ft., although a total of about 90,000 hp is available from the Columbia River at this point. The present station is designed for a normal rating of 2600 hp and the electricity is transmitted and drives apparatus in pumping stations located at other points of the river, thus taking water from the river and elevating it to high-level irrigating ditches. A complete description of this interesting installation is contained in Bulletin No. 1623 issued by the Allis-Chalmers Company, Milwaukee, Wis.

CIRCUIT-BREAKERS.—The General Electric Company has just issued seven bulletins (Nos. 4837 to 4843 inclusive) illustrating and describing in detail all of the circuit-breakers manufactured by that company. Bulletin No. 4837 contains a general description of the applications of circuit-breakers, and also notes and diagrams descriptive of standard practice in the use of carbon-break circuit-breakers for various requirements. Specifications are suggested for the use of engineers, architects, and others wishing to secure uniformity in quality of apparatus, and illustrations are given of typical installations of circuit-breakers on modern switchboards. Bulletin No. 4838 is devoted to circuit-breakers of large capacity for severe service, used in railway, motor and lighting installations, while Bulletin No. 4839 deals with intermediate capacities for any service used in lighting, motor and railway installations. Bulletin No. 4840 is devoted to circuit-breakers that are specially adapted to motor-driven tool applications, for use in mills, machine shops, factories, foundries and office buildings, and for general motor work, automobile-charging outfits, storage batteries, rectifier sets, etc. Bulletin No. 4841 describes circuit-breakers for small capacity motor, lighting and heating circuits. Bulletin No. 4842 refers to remote-control circuit-breakers for use in railway, lighting and power installations, especially in those cases where economy of space, ease of operation and distant control are deciding factors. Bulletin No. 4843 describes magnetic blowout circuit-breakers for railway and power service, and for use especially where the arc must be confined.

BUSINESS NOTES.

THE HASKINS GLASS COMPANY, Wheeling, W. Va., will develop a full line of indirect and semi-indirect lighting units, and with that end in view the company has retained as consulting engineer Mr. W. Godfrey Boyd.

THE ST. JOHN CORPORATION, 180 Broadway, New York, and the Mohawk Electric Company, Albany, N. Y., have consolidated and are now under the same management with two departments—sales department and manufacturing department.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces the resignation of Mr. Gano Dunn, adding that for a great many years he filled the position of chief engineer and first vice-president in the Crocker-Wheeler Company with conspicuous ability and that he leaves with the very best wishes of the company and his many friends and associates in it for his future success.

NICHOLSON ARC RINGS.—The Locke Insulator Company, Victor, N. Y., has taken over the exclusive handling of the Nicholson arcing rings for high-tension transmission lines. These rings are already in service on the lines of the Niagara, Lockport & Ontario Power Company, Chicago Sanitary District, Syracuse Rapid Transit and several other smaller installations, and their efficiency has been abundantly proven.

ENAMELED WIRE.—Alfred F. Moore, Philadelphia, has recently notified the trade that he is prepared to furnish enameled magnet wire, either plain or insulated, with silk or cotton, as desired. A complete stock is carried at the factory in Philadelphia and a supplementary stock at Cleveland for the Middle West trade. All of the bare wire used for enameling is specially drawn and has to pass a rigid examination before it is available for use, being subjected to physical and electrical tests that insure a uniformly high standard of quality throughout.

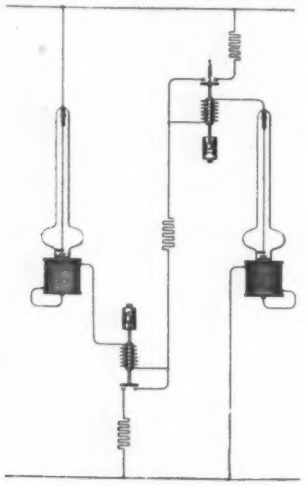
Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 29, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,001,627. ART OF COOKING; A. C. Dunham, Hartford, Conn. App. filed April 14, 1911. An insulated cooking chamber is continuously heated by a continuous flow of low-voltage current through a resistance of small capacity.

1,001,630. FILAMENT MOUNTING; E. S. Gardner, Acquackanonck, N. J. App. filed Nov. 17, 1910. A group of spaced carriers each



1,001,710.—System of Electrical Distribution.

having a filament arranged in a plurality of sections of different lengths. Particularly for car-lighting with tantalum, tungsten, etc.

1,001,636. TROLLEY; C. A. Gouty, Springfield, Ill. App filed June 23, 1910. Lubricating washers; spring-pressed wheel; yieldingly supported shaft.

1,001,637. ELECTRICAL OVEN; H. Gray, Accrington, Eng. App. filed April 20, 1911. Passages for circulation of the heated air.

1,001,643. DYNAMO-ELECTRIC MACHINE; F. B. Howell, Schenectady, N. Y. App. filed Dec. 30, 1909. A ventilating tube is embedded in the winding of the field coil.

1,001,647. SPEED REGULATOR FOR ELECTRIC MOTORS; J. T. Kalweit and W. H. Gaulke, Milwaukee, Wis. App. filed Oct. 20 1910. An electromagnet holds the contact arm in any position by means of a slide.

1,001,654. APPARATUS FOR HEATING WATER BY ELECTRICITY; C. Kratt, Glasgow, Scotland. App. filed Oct. 10, 1910. Water is passed through glass tubes containing particles of carbon through which an electric current flows.

1,001,685. TELEPHONE; A. G. Remhilt, Philadelphia, Pa. App. filed Sept. 7, 1910. The receiver is movably mounted on the mouthpiece of the transmitter and is adjustable to either ear. The line is automatically connected and disconnected when the receiver is moved into position for use.

1,001,694. FUSE PLUG. H. R. Sargent, Schenectady, N. Y. App. filed Jan. 8, 1910. A cup-shaped base carries the fusible element and terminals and has ventilating passages and grooves.

1,001,709. VAPOR-ELECTRIC APPARATUS; E. Thomson, Swampscott, Mass. App. filed March 14, 1904. An insulating tube contains a small thread of mercury beneath the surface of the electrode and is vaporized for starting the lamp.

1,001,710. SYSTEM OF ELECTRICAL DISTRIBUTION; E. Thomson, Swampscott, Mass. App. filed March 11, 1905. Mercury-vapor lamps are connected in parallel to start, and then changed over to series.

1,001,711. SYSTEM OF VOLTAGE REGULATION; A. A. Tirrill, Schenectady, N. Y. App. filed Jan. 4, 1909. A booster generator is in series with the exciter for a main generator, and the fields of the exciter and booster are simultaneously varied by a voltage regulator.

1,001,716. OIL SWITCH; J. M. Wallace, Newbold-Upon-Avon, Eng. App. filed Nov. 2, 1906. Hand-operated panel type with means for preventing twisting or bending of the leads.

1,001,723. TELEPHONE SYSTEM; C. S. Winston, Chicago, Ill. App. filed Nov. 22, 1907. Central-office signaling apparatus and circuits for three-wire central energy type.

1,001,737. CURRENT-LIMITING DEVICE; M. G. Diaz and A. A. y Gresillon, Madrid, Spain. App. filed Aug. 22, 1908. A thermostatic device to prevent the use of more current than that for which contract has been made.

1,001,742. ELECTRIC-TRAIN SIGNAL; E. F. Von Dreden, New York, N. Y. App. filed Aug. 16, 1910. The closing of the car doors by the guards signals the motorman.

1,001,758. INCUBATOR TEMPERATURE REGULATOR; I. B. Havourd, Elkhart, Ind. App. filed Sept. 16, 1909. A damper and lamp-wick regulator is moved by a motor controlled by a thermostat.

1,001,765. MOTOR-STARTING DEVICE FOR POLYPHASE CIRCUITS; W. O. Lum, Schenectady, N. Y. App. filed July 24, 1908. A relay in each phase controls an electromagnetic switch in another phase to open the circuit of one phase in case of failure of another.

1,001,796. SELF-ADJUSTABLE CONTACT MAKER FOR ELECTRIC SWITCHES; F. W. Young, Everett, Mass. App. filed Dec. 26, 1905. A yielding support to insure perfect seating of the bridge contact upon the blocks in a circuit-breaker type.

1,001,808. ATTACHMENT PLUG; D. E. Bown, Pittsburgh, Pa. App. filed April 6, 1911. For incandescent-lamp sockets. The side terminals may be attached or detached through the side of the casing.

1,001,876. ELECTROLYTIC CELL; P. McDorman, Dayton, Ohio. App. filed Dec. 29, 1910. For decomposing a salt solution to form bleaching liquid. Baffles to prevent loss of current passing through the liquid around the electrodes.

1,001,828. ELECTRIC SIGNAL FOR RAILWAYS; T. J. Empfield, Des Moines, Ia. App. filed Oct. 8, 1910. Block system with automatically car-operated unlocking devices and auxiliary hand-operated devices.

1,001,864. FASTENING FOR ELECTRICAL CONDUCTORS; R. H. Klauder, Philadelphia, Pa. App. filed Dec. 15, 1910. Spring jaws interlocked for holding the ends of wires of different sizes.

1,001,888. ELECTRIC-WELDING MACHINE; A. F. Reitzel, Charlestown, R. I. App. filed Dec. 24, 1908. A templet for the work is mounted upon, but insulated from, a current-bearing pressure block. For making two or more welds at the same time.

1,001,915. ELECTRIC FURNACE; J. Yngström, Falun, Sweden. App. filed March 15, 1910. A crucible forms the melting chamber and the material is fed down from a stack. A space between is filled with the material and forms a substitute for the usual vault.

1,001,948. COMBINED COVER AND SOCKET-PIECE; J. Hamilton, Jamaica Plain, Mass. App. filed Dec. 16, 1907. The cover has circuit terminals and is made of insulating material to fit a metal junction box.

1,001,959. TELEPHONE SELECTIVE-SIGNALING RINGER; H. L. Johnson, Topeka, Kan. App. filed March 3, 1908. For use with combined direct-current and alternating-current system of calling. Has an auxiliary magnet to increase the power and the volume of sound.

1,001,967. GAS BURNER; H. Lyon, Gloucester City, N. J. App. filed Oct. 7, 1910. Electric ignition for an inverted Welsbach.

1,001,975. APPARATUS FOR PRODUCING ELECTRIC OSCILLATIONS; J. Murgas, Wilkes-Barre, Pa. App. filed April 12, 1910. A member (having fans) rotates between two electrodes and forms therewith the spark-gap.

1,002,036. ELECTRICAL SOUND-PRODUCING DEVICE; E. E. Clement, Washington, D. C. App. filed Aug. 11, 1905. Two electromagnets induce different vibrations (as in an organ pipe) so as to vary the tone.

1,002,049. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Ft. Monroe, Va. App. filed Aug. 8, 1903. Two circuits having suitable electric constants are arranged to neutralize the effect on the receiver of disturbing influences.

1,002,050. RECEIVER FOR SIGNALING; R. A. Fessenden, Washington, D. C. App. filed April 11, 1904. One member is yieldingly held against a revolving disk so as continuously to change the point of contact.

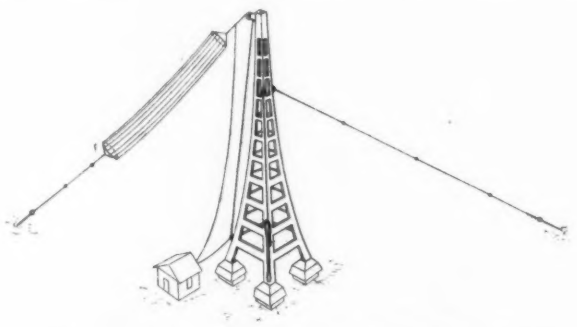
1,002,051. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed Feb. 8, 1907. An insulated ferro-concrete antenna support and an antenna arranged so that part of it shields the support from the electromagnetic waves.

1,002,052. ELECTRICAL SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed Dec. 23, 1907. A telephone transmitter has a self-responsive good contact of different materials. The impulses to be transmitted cause variation in the pressure of contact.

1,002,061. DROP-CORD CAP FOR ELECTRIC-CONDUIT OUTLET BOXES; C. S. Homsher, Denver, Col. App. filed Sept. 8, 1910. For connection without soldering. A porcelain block has a neck which projects inside the casing.

1,002,069. PROTECTIVE DEVICE; A. B. Marvin, Jr., Schenectady, N. Y. App. filed Feb. 15, 1907. A selective device readily transmitting high potential and high frequency, but opposing lower potential and lower frequency. A plurality of aluminum electrodes with convex surfaces approaching each other but separated by sodium nitrate.

1,002,087. RAILWAY SIGNAL; R. Skalicky and F. Mikulka, Vienna,



1,002,051.—Signaling by Electromagnetic Waves.

Austria-Hungary. App. filed May 31, 1911. Electromagnetically operated device for preventing "line free" signals while a train is in the danger zone.

1,002,141. DETERMINING THE POSITION OF VESSELS; R. F. Fessenden, Washington, D. C. App. filed Dec. 4, 1904. A "wireless" system consisting of a series of fixed stations having means for sending out signals of predetermined intensity. A receiving device on the vessel and means for comparing the signals received with a standard signal produced on the vessel.

1,002,181. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed June 23, 1908. Division from the application of Patent No. 927,602. A selector system for railway telegraphy.